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(71) Applicants:
- TOYODA GOSEI CO., LTD.
Nishikasugai-gun Aichi-ken (JP)
- TOYOTA JIDOSHA KABUSHIKI KAISHA
Aichi-ken 471-8571 (JP)

(72) Inventors:
- Tanase, Toshinori,
c/o Toyoda Gosei Co., Ltd.
Nishikasugai-gun, Aichi-ken (JP)
- Ohono, Mitsuyoshi,
c/o Toyota Jidosha Kabushiki K.
Toyota-shi, Aichi-ken 471-8571 (JP)

(74) Representative:
Tiedtke, Harro, Dipl.-Ing. et al
Patentanwaltsbüro
Tiedtke-Bühling-Kinne & Partner
Bavariaring 4
80336 München (DE)

(54) Airbag for head protecting airbag system

(57) An airbag (20) for a head protecting airbag system (M1) is adapted to be folded up and accommodated along an upper interior edge of a vehicle and to be developed and inflated to cover an interior opening (W) of the vehicle. The airbag (20) comprises a flexible airbag body (21) and a flexible belt portion (40). The airbag body (20) includes an inflatable portion (22) adapted to be inflated to cover the interior opening (W) when the airbag (20) is inflated. The inflatable portion (22) includes a longitudinal rod portion (29) adapted to be inflated substantially vertically into a column shape. The longitudinal rod portion (29) is arranged on one end side of the front end side or the rear end side of the inflatable portion (22). The belt portion (40) is joined at its proximal portion (40b,c) to the peripheral edge of the longitudinal rod portion (29) and is fixed at its distal end portion (40d) on the vehicle. When the airbag body (21) is inflated, the lower end side (29b) of the longitudinal rod portion (29) may be turned on the upper end side (29a) of the longitudinal rod portion (29) in the forward or backward direction away from the inflatable portion (24). Thus, a high tension (F) is established on the lower edge (21a) of the airbag body (21).

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ger properly substanti[illegible]ver its entire area.

[0014] Moreover, the length of said belt portion, as extended straight from the proximal portion to the distal end portion, is desirably made smaller than the distance which is measured in a predetermined state between the proximal portion to a fixing portion of the distal end portion on said opening peripheral edge. In this predetermined state, the airbag body is mounted on the vehicle, and is developed but not inflated.

[0015] The following actions and effects can be obtained when the airbag is constructed as described hereinbefore. Specifically, the belt portion can be short in length. During inflation, therefore, the turning torque can be reliably applied to the longitudinal rod portion. As a result, a high tension is applied to the lower edge side of the airbag body. Here, the belt portion has a short length. However, the belt portion and the airbag body are flexible. Therefore, the belt portion can be easily pulled out when the airbag is folded up and mounted in the vehicle. As a result, the distal end portion of the belt portion can be easily attached to the vehicle when the airbag is to be mounted on the vehicle.

[0016] On the other hand, the construction of the belt portion may be modified in the following manner. The belt portion may be joined at the proximal portion to the circumferential edge of the upper end of said longitudinal rod portion. On the other hand, the belt portion may be fixed at said distal end portion on the vehicle through an insert hole formed in the circumferential edge of the lower end of the longitudinal rod portion.

[0017] The following actions and effects can be obtained when the airbag is constructed as described hereinbefore. When the airbag is folded up and accommodated along an upper interior edge of the vehicle, the belt portion can be let out to the distal end portion through the insert hole. Therefore, even if the belt portion is shortened, the distal end portion of the belt portion can be easily fixed on the vehicle, and the belt portion can be shortened so that a high turning torque can be applied to the longitudinal rod portion during inflation. Without degrading the mounting workability on the vehicle, therefore, a high tension can be exhibited on the lower edge of the airbag body at the time of inflation.

[0018] Moreover, the construction of the belt portion may be modified in the following manner. The belt portion may be trifurcated to have three end portions. Two of the three end portions of said belt portion are joined proximalat the proximal portion to the upper and lower portions of the circumferential edge of the longitudinal rod portion. The remaining one of the three end portions of the belt portion is fixed at the distal end portion on the vehicle.

[0019] The following actions and effects can be obtained when the airbag is constructed as described hereinbefore. When the airbag is to be folded up and accommodated along the upper interior edge side of the vehicle, more specifically, the bifurcated proximal portions of the b[illegible]rtion on the side of the longitudinal rod portion come closer to each other. Also, the belt portion from the proximal portion to the distal end portion is elongated. Therefore, the distal end portion of the belt portion is easily fixed on the vehicle. When the airbag is developed and inflated, on the other hand, the bifurcated proximal portion is vertically separated by the formation of the longitudinal rod portion. Also, the substantial length of the belt portion from the proximal portion to the distal end portion is reduced. This makes it possible to apply a high turning torque to the longitudinal rod portion. Without degrading the mounting workability on the vehicle, therefore, a high tension can be exhibited at the lower edge of the airbag body at the time of inflation.

[0020] The aforementioned second object can be achieved by the airbag for the head protecting airbag system having the following construction. The airbag is folded up and accommodated along the upper interior edge of the vehicle in the interior of a vehicle and is developed and inflated to cover the interior opening. The airbag has an inflatable portion and a gas inlet portion. The inflatable portion is formed into a bag shape, and is inflated to cover an interior opening of the vehicle. The gas inlet portion is arranged on one end side of the front end side or the rear end side of the inflatable portion for introducing an inflation gas into the inflatable portion. On the other hand, the inflatable portion includes a main chamber and upper and lower auxiliary chambers. The main chamber is arranged to extend along a substantially straight path and substantially horizontal direction from the gas inlet portion. The upper and lower auxiliary chambers are arranged over and below the main chamber, respectively, in communication with the end portion of the main inflating chamber, spaced from the gas inlet portion.

[0021] In the aforementioned airbag for the head-protecting airbag system, the incoming inflation gas is introduced into the main chamber of the inflatable portion through the gas inlet portion. The inflation gas is further introduced from the main chamber into the upper and lower auxiliary chambers.

[0022] Specifically, the main inflating chamber is inflated before the airbag finishes inflating by the inflow of the inflation gas into the upper and lower auxiliary chambers. The main chamber is arranged to extend substantially along a straight path and substantially horizontal direction from the gas inlet portion. Therefore, the main chamber is quickly inflated. On the other hand, the main chamber is arranged long in the longitudinal (fore and aft) direction at the vertically intermediate portion of the upper and lower auxiliary chambers, that is, at the vertically intermediate portion of the inflatable portion. Therefore, the airbag is inflated over a wide area by the main chamber.

[0023] In the airbag for the head-protecting airbag system according to the present invention, therefore, the main chamber can be inflated quickly and widely

Fig. 25 is a front elevation showing a developed state at an uninflated time of an airbag in accordance with a thirteenth embodiment;

Fig. 26 is a front elevation showing a developed state at an uninflated time of an airbag in accordance with a fourteenth embodiment;

Fig. 27 is a front elevation taken from the inside of a vehicle and shows the state in which an airbag in accordance with a fifteenth embodiment is accommodated;

Fig. 28 is an enlarged schematic sectional view taken along line XXVIII - XXVIII of Fig. 27;

Fig. 29 is an enlarged schematic sectional view taken along line XXIX - XXIX of Fig. 27;

Fig. 30 is an enlarged sectional view taken along line XXX - XXX of Fig. 27;

Fig. 31 is a front elevation showing a developed state at an uninflated time of the airbag in accordance with the fifteenth embodiment;

Fig. 32 is a diagram showing the folds, along which the airbag in accordance with the fifteenth embodiment is to be folded;

Fig. 33 is a front elevation in the completely inflated state of the airbag itself in accordance with the fifteenth embodiment;

Fig. 34 is a sectional view showing the airbag in accordance with the fifteenth embodiment at the completely inflated time and presents an enlarged sectional view taken along line XXXIV - XXXIV of Fig. 33;

Fig. 35 is a front elevation taken from the inside of a vehicle and shows the state in which an airbag in accordance with a sixteenth embodiment is accommodated;

Fig. 36 is an enlarged schematic sectional view taken along line XXXVI - XXXVI of Fig. 35;

Fig. 37 is an enlarged schematic sectional view taken along line XXXVII - XXXVII of Fig. 35;

Fig. 38 is a front elevation showing a developed state at an uninflated time of the airbag in accordance with the sixteenth embodiment;

Fig. 39 is a diagram showing the folds, along which the airbag of the sixteenth embodiment is to be folded;

Fig. 40 is a front elevation in the completely inflated state of the airbag itself of the sixteenth embodiment;

Fig. 41 is a sectional view showing the airbag of the sixteenth embodiment at the completely inflated time and presents an enlarged sectional view taken along line XXXXI - XXXXI of Fig. 40;

Fig. 42 is a front elevation showing an inner plate portion of a mounting bracket to be used for mounting the airbag in accordance with the sixteenth embodiment on a vehicle, and is taken in the direction XXXXII of Fig. 44;

Fig. 43 is a front elevation showing an outer plate portion of the mounting bracket to be used for mounting the airbag in accordance with the sixteenth embodiment on the vehicle, and is taken in the direction XXXXIII of Fig. 44;

Fig. 44 is a side elevation showing the mounting bracket to be used for mounting the airbag in accordance with the sixteenth embodiment on the vehicle; and

Fig. 45 is a partial sectional view showing the state in which the sane mounting bracket is mounted on the airbag and presents an enlarged sectional view taken along line XXXXV - XXXXV of Figs. 42 and 43.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] The invention will now be described in connection with its embodiments with reference to the accompanying drawings. The following description is not exhaustive of the scope of this invention. Rather, modifications and variations as are covered by the appended claims fall within the scope of the invention.

[0030] An airbag 20 of a first embodiment, as shown in Figs. 1 to 8, is employed in a head-protecting airbag system M1. Prior to inflation, the airbag 20 is folded and accommodated on the upper edge portion of the vehicle proximal to opening W of a door or window. Specifically, the airbag 20 is folded and arranged from a front pillar portion PF to a roof side rail portion R. The roof side rail portion R extends rearward from the upper portion of the front pillar portion PF over a center pillar portion PC.

[0031] The head-protecting airbag system M1 comprises the airbag 20, an inflator 18, a mounting bracket 15 and an airbag cover 11.

[0032] In the illustrated embodiment, the inflator 18 is of the cylinder type, and feeds the folded airbag 20 with an inflation gas. The inflator 18 is sheathed with a later-described joint cylinder portion 23a of the airbag 20.

[0033] The mounting bracket 15 can be made of a sheet metal. This mounting bracket 15 mounts the inflator 18 on a side panel 2 with bolts 16. This inflator 18 is sheathed with the joint cylinder portion 23a. The mounting bracket 15 clamps the outer circumference of the joint cylinder portion 23a and mounts the inflator 18 on the side panel 2.

[0034] The airbag cover 11 comprises a front pillar garnish 12 of the front pillar portion PF and a roof interior cover 13 of the roof side rail portion R. The pillar garnish 12 is made of a synthetic resin and is mounted and fixed, as shown in Figs. 1 and 2, on an inner panel 7 of a front pillar body 4 by mounting means (not shown). The pillar garnish 12 has a door portion 12a on its lower edge side. This door garnish 12a is opened by inflation of the airbag 20 to thereby create a passageway for passage of the airbag 20. The roof interior cover 13 is also made of a synthetic resin and is mounted and fixed, as shown in Figs. 1 and 3, on a roof side rail body 9 of a sheet metal by mounting means (not shown).

ing portion 36 and th[redacted] edge 32a of the peripheral edge portion 32.

[0044] The mounting portions 38 are formed in plurality at the peripheral edge portion 32 on the upper edge side of the gas inlet portion 23 and the inflatable portion 24. Each mounting portion 38 is provided at its center with a mounting hole 38a. Into this mounting hole 38a, there is inserted a mounting bolt 46. The airbag body 21 is bored after the hollow-weaving work to form the individual mounting holes 38a. On the individual mounting portions 38, as shown in Fig. 1 to 3, there are fixed mounting brackets 45 which are made of a sheet metal. These mounting brackets 45 mount the folded airbag 20 in the body 1 (e.g., the inner panel 7 and the roof side rail body 9).

[0045] Each mounting bracket 45 has an interior side inner plate 45a and an exterior side outer plate 45b. These inner and outer plates 45a and 45b are provided with mounting holes 45c corresponding to the mounting holes 38a of the individual mounting portions 38. When each mounting bracket 45 is to be mounted on the mounting portion 38, this mounting portion is arranged at first between the inner and outer plates 45a and 45b. Then, these inner and outer plates 45a and 45b are so partially deformed plastically as to joint each other and are mounted on each mounting portion 38. As shown in Figs. 2 and 3, the mounting bolt 46 is inserted into the mounting holes 45c and 38a and is fastened into nuts 7b and 9b. These nuts 7b and 9b are fixed on the circumferential edges of mounting holes 9a and 7a of the inner panel 7 and the roof side rail body 9. As a result, the folded airbag body 21 is mounted in the body 1 by those bolts 46.

[0046] The belt portion 40 is formed of a woven fabric of flexible polyamide yarns or the like. The belt portion 40 is trifurcated to have three joint fingers 41, 42 and 43. These joint fingers 41, 42 and 43 are joined at an intersection 40a. In the belt portion 40, the end portions of the two joint fingers 41 and 42 spaced from the intersection 40a are located on the sides of proximal portions 40b and 40c. The proximal portions 40b and 40c are joined to the circumferential edge of the longitudinal rod portion 29. Specifically, the proximal portions 40b and 40c are stitched and joined to the upper and lower portions of the rear edge 32a of the peripheral edge portion 32. In the belt portion 40, on the other hand, the end portion of the remaining joint finger 43 spaced from the intersection 40a is located on the side of a distal end portion 40d. The distal end portion 40d is fixed on the roof side rail body 9 of the vehicle proximal to the opening W by means of the bolts 46.

[0047] Here, the distal end portion 40d is provided with a mounting hole 43a for inserting the bolt 46 thereinto. The distal end portion 40d is equipped with the mounting bracket 45 capable of inserting the bolt 46 thereinto. Moreover, the individual joint fingers 41, 42 and 43 are substantially the same length.

[0048] Moreover, the belt portion 40 is given a length corresponding [redacted]hen its joint fingers 41 and 42 are brought as close to each other as to overlap each other so that it is extended straight from the proximal portions 40b and 40c to the distal end portion 40d. At this time, more specifically, the belt portion 40 has a length X0 (X0 = A + B) (as shown in Fig. 5) smaller than the distance Y at the time when the airbag body 21 is set in a predetermined state. In this predetermined state, the airbag body 21 is mounted in the vehicle and is deflated (i.e., without any feed of the inflation gas). Moreover, the distance Y at this time is a distance from the lower proximal portion 40c to a portion P at which the distal end portion 40d is fixed on the peripheral edge of the opening W. In this embodiment, the length X0 = 410 mm, and the distance Y = 470 mm.

[0049] Here, this length X0 is so set that a length Z = X0 + C is substantially equal to or larger than a predetermined mounting span S (as shown in Fig. 1) (that is, $S \leq Z = X0 + C$). This setting is made so that the folded airbag 20 may be fixed without fail on the vehicle by means of the bolts 46. Here, the mounting span S is a distance between the mounting portion 38 (B) of the rear end portion of the airbag body 21 and the distal end portion 40d of the joint finger 43 (that is, the distance between the fixed portions of the airbag 20). On the other hand, the length C is a length in the forward and backward direction between the mounting hole 38a (B) of the rear end portion of the airbag body 21 and the stitched portions 40b and 40c of the joint fingers 41 and 42 to the rear edge 32a.

[0050] Here will be described the assembly operation for mounting the airbag 20 on the vehicle. First, the airbag 20 is folded up. For this folding-up, the airbag 20 in the uninflated developing state, as shown in Fig. 4, is folded in a bellows shape from its lower to upper edge side. Then, the folds are formed along a line L in parallel with the lower edge 32b of the peripheral edge portion 32 in the uninflating portion 31.

[0051] Then, the airbag body 21 thus folded up is wound at a predetermined interval with a breakable tape so that it may not collapse (or may not be unfolded to restore the developing shape).

[0052] After folding-up the airbag body 21, the individual mounting portions 38 and the distal end portion 40d of the joint finger 43 are pulled out. Then, the mounting brackets 45 are attached to the individual mounting portions 38 and the distal end portion 40d. The joint cylinder portion 23a is pulled out, and the inflator 18 is inserted into the joint cylinder portion 23a. Moreover, the mounting bracket 15 is attached to the outer circumference of the joint cylinder portion 23a to prepare an airbag assembly. Thus, a standby state is established for awaiting the mounting on the vehicle.

[0053] After this, the mounting bracket 15 is arranged at a predetermined position of the side panel 2 and is fixed on the side panel 2 by means of the bolts 16. Each mounting bracket 45 is arranged at a predetermined position of the inner panel 7 and the roof side rail body

[0065] In the airbag [redacted] in accordance with the first embodiment, the upper and lower regulating portions 35 and 36 are arranged in a direction to intersect a rear edge 32a arranged vertically of the peripheral edge portion 32, as shown in Fig. 4. On the side of the rear portion 25a of the main inflating chamber 25, more specifically, there is arranged the rear edge 32a of the uninflating portion 31 which extends vertically over the upper and lower auxiliary inflating chambers 26 and 27. On the side of the rear portion 25a of the main inflating chamber 25, the inlets 26a and 27a of the upper and lower auxiliary inflating chambers 26 and 27 are arranged to confront each other vertically. At the initial stage of the inflow of the inflation gas G, therefore, the inflation gas G having passed through the main inflating chamber 25 is vertically guided by the guide of the vertically extending rear edge 32a. Then, the inflation gas G flows through the inlets 26a and 27a, respectively, into the upper and lower inflating chambers 26 and 27. As a result, the inflation gas G can inflate the upper and lower inflating chambers 26 and 27 with ease.

[0066] In the airbag 20 in accordance with the first embodiment, moreover, the inlets 26a and 27a of the upper and lower auxiliary inflating chambers 26 and 27 are made such that the inlet 27a has a larger opening area than that of the inlet 26a. This causes a quicker inflation of the lower inflating chamber 27 than the upper inflating chamber 26. Moreover, the lower inflating chamber 27 provides the area which is located apart from the peripheral edge of the opening W so that it can restrain the passenger more smoothly than the upper inflating chamber 26. As a result, the airbag 20 can better improve passenger restraint before the inflation is complete.

[0067] Here, when the trifurcated belt portion 40 is employed as in the airbag 20 in accordance with the first embodiment, the three joint fingers 41, 42 and 43 need not be the same length. For example, an airbag 50 according to a second embodiment may be constructed, as shown in Fig. 9. Specifically, the joint fingers 41 and 42 on the side of the proximal portions 40b and 40c may be made shorter than the joint finger 43 on the side of the distal end portion 40d. Similarly to the first embodiment, in the airbag 50 in accordance with the second embodiment, the joint fingers 41 and 42 are brought closer to overlap each other so that the length X0 ($X0 = A + B$) of the belt portion 40 extended from the proximal portions 40b and 40c to the distal end portion 40d is shorter than the distance Y in the uninflated state. In the uninflated state, the airbag body 21 is attached to the vehicle and developed in the uninflated state. Moreover, the distance Y is measured in the uninflated state from the proximal portion 40c on the lower side to the fixing portion P of the distal end portion 40d on the peripheral edge of the opening W. The length X0 is so set that the length Z of X0 + C is substantially equal to or larger than the mounting span S ($S \leq Z = X0 + C$). This setting is made for fixing the folded airbag 5[redacted]liably to the vehicle by means of bolts 46. The mounting span S is a distance between the fixing portions, i.e., the mounting portion 38(B) of the rear end portion of the airbag body 21 and the distal end portion 40d of the joint finger 43.

[0068] Moreover, the belt portion 40 need not be trifurcated but may be modified into one belt portion 61 of an airbag 60 according to a third embodiment, as shown in Fig. 10. In this airbag 60, too, the length X0 of the belt portion 61, as extended straight from a proximal portion 61a to a distal end portion 61b, is shorter than the distance Y in the uninflated state. In the uninflated state, the airbag body 21 is attached to the vehicle and is developed but not inflated. Moreover, the distance Y is taken from the proximal portion 61a to the fixing portion P of the distal end portion 61b on the peripheral edge of the opening.

[0069] In the airbag 60 according to the third embodiment, the length X0 of the belt portion 61 is short when the airbag 60 is developed and inflated after being mounted to the vehicle. As a result, the belt portion 61 applies the turning torque reliably to the longitudinal rod portion 29 so that the high tension F may act on the lower portion 21a of the airbag body 21. The belt portion 61 and the airbag body 21 are made of a flexible fabric material. As a result, the airbag 60 can be easily mounted on the vehicle proximal to the opening on the interior side of the vehicle even if the belt portion 61 is short. Specifically, the airbag 60 is folded in the bellows shape from the lower portion 32b to the upper portion 32c while forming folds along the line L in parallel with the lower portion 32b of the peripheral portion 32. At this folding time, however, the belt portion 61 and the airbag body 21 are so flexible that the belt portion 61 can be easily pulled out.

[0070] Here, the belt portion 61 is provided at its distal end portion 61b with a mounting hole 61c for inserting the mounting bolt 46 thereinto. The mounting bracket 45 is attached to the distal end portion 61b and in the mounting portion 38 having the mounting hole 38a. As a result, the distal end portion 61b is fixed on the vehicle by means of the bolt 46.

[0071] Now, when the single belt 61 is employed, the proximal portion 61a is joined to the lower end 29b of the peripheral edge of the longitudinal rod portion 29 rather than the upper end 29b of the longitudinal rod portion 29, because a higher backward turning torque can act on the longitudinal rod portion 29 when the airbag 60 is to be developed and inflated. This turning torque turns the lower end 29b on the upper end 29a away from the inflatable portion 24 in the longitudinal (fore and aft) direction.

[0072] When the single belt portion is employed, moreover, the airbag may be constructed, as designated by 70 in Fig. 11, according to a fourth embodiment. This airbag 70 is provided with an insert hole 32d in the peripheral edge portion 32 (i.e., the rear edge 32a) on the side of the lower end 29b of the longitudinal

each other, or alternatively by folding one sheet of fabric material in two and by stitching or adhering the peripheral edges to each other.

[0086] In the individual embodiments, moreover, the airbags 20, 50, 60, 70, 80 and 90 are exemplified by arranging them over the front pillar portion PF and the roof side rail portion R. However, the airbags may also be arranged over the rear pillar portion and the roof side rail portion R of the rear portion of the vehicle. In these modifications, for example, the shown individual airbags 20, 50, 60, 70, 80 and 90 may be arranged in the reverse of the longitudinal (fore and aft) direction.

[0087] Still moreover, the airbags may be arranged over the center pillar portion PC and the roof side rail portion R extending forward or backward from above the center pillar portion PC.

[0088] Moreover, the airbag may be constructed, as designated by 100 in Figs. 14 to 18, according to a seventh embodiment. This airbag 100 is provided with an airbag body 101 and a belt portion 120, which are made individually flexible. The airbag 100 is further provided with a cover portion 113. This cover portion 113 is arranged in a triangular area extending from the circumferential edge of a longitudinal rod portion 109 to the vicinity of a distal end portion 120d of the belt portion 120. The cover portion 113 holds a portion in the vicinity of the distal end portion 120d of the belt portion 120 movably in the axial direction thereof.

[0089] Here, the airbag body 101 is formed into a bag shape by the hollow-weaving method using polyamide yarns or the like. The belt portion 120 is joined to the rear end side of the airbag body 101.

[0090] The airbag body 101 is provided with an inflating portion 102 and an uninflating portion 111. The inflating portion 102 is developed from the folded state and inflated by the inflow of the inflation gas from the inflator 18 increasing its width. The uninflating portion 111 does not admit the inflation gas. Here, this airbag body 101 may also be coated on its surface with silicone or the like after it was hollow-woven to form the individual portions 102 and 111. The silicone or the like can enhance the heat resistance and the sealing properties of the airbag body 101.

[0091] The inflating portion 102 comprises a gas inlet portion 103 and an inflatable portion 104. This inflatable portion 104 is inflated to cover the opening W on the inner side of the vehicle when the airbag 100 is developed and inflated. Similarly to the other embodiments, the inflatable portion 104 covers the center pillar portion PC, when the airbag 100 is developed and inflated.

[0092] The inlet portion 103 is formed into a cylindrical shape having an opened front end. The gas inlet portion 103 is arranged on the front end side of the inflatable portion 104. The inflator 18 is inserted into the gas inlet portion 103. Moreover, the gas inlet portion 103 is clamped on the inflator 18 by the mounting bracket 15. As a result, the gas inlet portion 103 is joined to the inflator 18. Here, an inner tube may be additionally fixed on the inflating chamber of the gas inlet portion 103 so as to retain the heat resistance. The inner tube is made of the same material or the like as that of the airbag body 101 itself.

[0093] The inflatable portion 104 comprises a main inflating chamber 105 and upper and lower auxiliary inflating chambers 106 and 107. The main inflating chamber 105 extends straight backward from the gas inlet portion 103. The upper and lower auxiliary inflating chambers 106 and 107 are arranged over and below the main inflating chamber 105 and in communication with a rear portion 105a of the main inflating chamber 105. In this embodiment, moreover, the longitudinal rod portion 109 comprises the rear portion 105a of the main inflating chamber 105 and rear portions 106b and 107b of the upper and lower auxiliary inflating chambers 106 and 107. The longitudinal rod portion 109 is inflated in a substantially vertical cylinder shape when the inflation gas flows thereinto. Here, the area of the longitudinal rod portion 109 is arranged in front of a later-described rear edge 112a (or the cover portion 113) of the uninflating portion 111. The area of the longitudinal rod portion 109 in Fig. 15 is hatched that it can be easily identified.

[0094] The uninflating portion 111 comprises a peripheral edge portion 112 and a regulating portion 114. The peripheral edge portion 112 is arranged on the outer circumferential edges of the gas inlet portion 103 and the inflatable portion 104. The peripheral edge portion 112 is woven so densely as prevent gas leaks. The regulating portion 114 is extended backward from the front portion of the peripheral edge portion 112 and arranged in the region of the inflatable portion 104. The regulating portion 114 comprises upper and lower regulating portions 115 and 116 and an upper auxiliary regulating portion 117. The upper and lower regulating portions 115 and 116 define the main inflating chamber 105 and the upper and lower auxiliary inflating chambers 106 and 107. The upper auxiliary regulating portion 117 is arranged to give a predetermined thickness to the upper auxiliary inflating chamber 106. Here, the airbag body 101 is provided with clearances for gas inlets 106a and 107a, respectively, between rear ends 115a and 116a of the upper and lower regulating portions 115 and 116 and the rear edge 112a of the peripheral edge portion 112. The upper and lower auxiliary inflating chambers 106 and 107 admit the inflation gas from those gas inlets 106a and 107a.

[0095] On the side of an upper edge 112c of the peripheral edge portion 112, there are formed a plurality of mounting portions 118. Each of these mounting portions 118 is provided with a mounting hole 118a at its center. This mounting hole 118a is bored into the airbag body 101 after the hollow-weaving work. The mounting bolt 46 is inserted (as shown in Fig. 14) into this mounting hole 118a, as in the first embodiment. The mounting bracket 45 is fixed on the mounting portion 118, as in the first embodiment. The folded airbag 100 is mounted in the inner panel 7 and the roof side rail body 9 of the

nish 12 and the roof in[illegible]cover 13 to open the individual door portions 12a and 13a. Moreover, the airbag body 101 is inflated so largely as to cover the opening W, as indicated by the double-dotted lines in Fig. 14.

[0107] In the airbag 100 of the seventh embodiment, the inflating portion 102 is developed and inflated by the inflation gas G so that the longitudinal rod portion 109 is arranged in the substantially vertical direction. Then, the belt portion 120 pulls on the longitudinal rod portion 109 causing it to turn. In other words, the belt portion 120 turns the lower end 109b backward, i.e., in the longitudinal (fore and aft) direction away from the inflatable portion 104 on the upper end 109a.

[0108] At this time, the longitudinal rod portion 109 is inflated substantially vertically in the rod shape by the inflation gas C coming thereinto. In short, the longitudinal rod portion 109 becomes rigid. Then, the longitudinal rod portion 109 is subjected to a backward turning torque. As a result, a tension F by the belt portion 120 is applied to the lower edge 101a of the airbag body 101, as shown in Fig. 17. On the other hand, the airbag body 101 is inflated into the interior side of the center pillar portion PC, as shown by the double-dotted lines in Fig. 14. As a result, the airbag 100 will be supported by the center pillar portion PC, even when it is restraining the passenger, and will barely extend outside of the vehicle.

[0109] Moreover, the uninflating portion 111 of the airbag body 101 is provided with the cover portion 113. This cover portion 113 is arranged in a triangular area extending from the circumferential edge of the longitudinal rod portion 109 to the vicinity of the distal end portion 120d of the belt portion 120. As a result, the cover portion 113 can suppress the formation of the clearance between the airbag body 101 and the belt portion 120.

[0110] Therefore, the airbag 100 of the seventh embodiment can exhibit a tension especially on the side of the lower edge 101 of the airbag body 101 when the airbag 100 is inflated. As a result, the airbag 100 can retain a wide area capable of restraining the passenger properly. Moreover, the airbag 100 is enabled to restrain the passenger properly over a wider range by the cover portion 113, because the cover portion 113 removes a clearance between the airbag body 101 and the belt portion 120.

[0111] Moreover, the cover portion 113 is constructed of the uninflating portion 111 so as to not admit inflation gas G. As a result, the cover portion 113 does not increase the capacity of the inflating portion 102 of the airbag body 101. In other words, the cover portion 113 does not delay the time period for the inflating portion 102 to be charged with the inflation gas G. As a result, the cover portion 113 does not increase the time it takes to fully inflate the airbag.

[0112] The cover portion 113 holds the vicinity of the distal end portion 120d of the belt portion 120 so that the distal end portion 120d may move in the axial direction. As a result, the belt portion 120 can be freely moved when it exhibits tension. The cover portion 113 does not defo[illegible]e developed and inflated shape of the airbag body 101.

[0113] In the airbag 100 of the seventh embodiment, moreover, the belt portion 120 is arranged on the exterior faces 113E of the cover portion 113. Therefore, the passenger is kept, when he or she is to be restrained by the cover portion 113, away from direct contact with the belt portion 120 exhibiting the tension. As a result, the passenger has confidence in the airbag 100.

[0114] In this embodiment, too, the length X0 of the belt portion 120, as taken straight from the proximal portion 120c to the distal end portion 120d, is set shorter than the length Y in the uninflated state. In the airbag 100 being inflated, therefore, a high tension can be reliably applied to the lower edge 101a of the airbag body 101.

[0115] The belt portion 120 of the seventh embodiment is also trifurcated. As in the first embodiment, therefore, the distal end portion 120d of the belt portion 120 can be easily fixed on the fixing portion P proximal to the opening W by means of the bolts 46. When the airbag 100 is developed and inflated, the bifurcated proximal portions 120b and 120c are vertically separated by the formation of the longitudinal rod portion 109. Without degrading the mounting workability on the vehicle, therefore, a high tension can be exhibited on the lower portion 101a of the airbag body 101 being developed and inflated.

[0116] Here in the airbag 100 of the seventh embodiment, the cover portion 113 is provided with the insert hole 113a. Moreover, the distal end portion 120d of the belt portion 120 is guided from the exterior face 113E through the insert hole 113a and arranged inside of the vehicle. However, the distal end portion 120d of the belt portion 120 may be constructed as in an airbag 130 of an eighth embodiment, as shown in Figs. 19 and 20, if it can be held movable in the axial direction. In this airbag 130, the exterior face 113E of the cover portion 113 is provided with a loop portion 132 capable of inserting the distal end portion 120d thereinto. This loop portion 132 is attached to the cover portion 113 by stitching or adhering the upper and lower two ends of a band 131. In this case, the vicinity of the distal end portion 120d can also be arranged on the exterior side of the cover portion 113.

[0117] Still moreover, the construction of the loop portion 132 may be modified, as in an airbag 140 in accordance with a ninth embodiment shown in Fig. 21. This airbag 140 is further provided a second slit-shaped insert hole 113b in the rear edge side of the cover portion 113 in the vicinity of the insert hole 113a. The distal end portion 120d can be inserted into the insert hole 113b. Moreover, the distal end portion 120d, as extending from the intersection 120a, is extended once to the interior of the vehicle from the first insert hole 113a and further through the second insert hole 113b to the exterior of the vehicle.

[0118] When the trifurcated belt portion 120 is used,

structed, as shown in [redacted]6. This main inflating chamber 25 extends with a slight curve in the longitudinal (fore and aft) direction. If the main inflating chamber 25 is inflated quickly and widely, more specifically, the main inflating chamber 25 may be arranged to extend substantially linearly from the gas inlet portion 23 in the longitudinal (fore and aft) direction while including the straight extending case.

[0128] In the airbag 20 in accordance with the first embodiment, still moreover, the upper and lower auxiliary inflating chambers 26 and 27 are individually provided by one chamber. However, the upper and lower auxiliary inflating chambers 26 and 27 may be suitably divided. For example, the construction may be modified as in the airbag 180 shown in Fig. 25. In this airbag 180, a second lower regulating portion 186 is provided below the lower regulating portion 36. The second lower regulating portion 186 extends from the lower edge 32b in the peripheral edge portion 32 of the uninflating portion 31. In this airbag 180, the lower inflating chamber 27 is divided into two by the second lower regulating portion 186. As in the airbag 190 shown in Fig. 26, alternatively, a second upper regulating portion 195 may be provided over the upper regulating portion 35. This second upper regulating portion 195 extends from the upper edge 32c in the peripheral edge portion 32 of the uninflating portion 31. In this airbag 190, the upper inflating chamber 26 is divided into two by the second upper regulating portion 195.

[0129] Here, the upper and lower auxiliary inflating chambers 26 and 27 may be partitioned, when divided, by a regulating portion which extends from the rear edge 32a in the peripheral edge portion 32 of the uninflating portion 31. As in the airbag 190 shown in Fig. 26, for example, a second lower regulating portion 196 for dividing the lower auxiliary inflating chamber 27 may extend from the rear edge 32a.

[0130] Here, the regulating portions 35, 36, 115, 116, 117, 186, 195 and 196 are desirably provided substantially in parallel with each other as in the airbags 20, 100, 180 and 190, because the width of the inflating chambers 25, 26, 27, 105, 106 and 107 being inflated can be equalized as much as possible in the longitudinal (fore and aft) direction.

[0131] In the airbag 20 of the first embodiment, moreover, the belt portion 40 is disposed at the back of the airbag body 21. If the main inflating chamber 25 is inflated quickly and widely, however, the belt portion 40 may be omitted as in the airbags 180 and 190 shown in Figs. 25 and 26. In these airbags 180 and 190, the rear edge 32a of the peripheral edge portion 32 in the uninflating portion 31 of the airbag body 21 is formed into a triangular sheet.

[0132] The first to fourteenth embodiments have described an airbag which is employed in the head-protecting airbag system M1 for the front seat. However, the airbag may be constructed to be arranged on the front and rear seats. A head protecting airbag system M2, as shown in [redacted]gs. 27 to 30, is provided for the front and rear seats. Moreover, an airbag 220 according to a fifteenth embodiment is folded and accommodated in the upper edge side of the opening W of the door or window on the interior side. Specifically, the airbag 220 is arranged to extend over the front pillar portion PF, the roof side rail portion R and a rear pillar portion PR.

[0133] This head-protecting airbag system M2 comprises the airbag 220, the inflator 18, the mounting bracket 15 and the airbag cover 11.

[0134] The inflator 18 and the mounting bracket 15 are made as in the first embodiment, and their description will be omitted. However, the mounting bracket 15 uses two bolts 16 to mount the inflator 18 on a rear pillar body 10 of the rear pillar portion PR.

[0135] The airbag cover 11 comprises the front pillar garnish 12 of the front pillar portion PF, the roof interior cover 13 of the roof side rail portion R, and a rear pillar garnish 14. This rear pillar garnish 14 is arranged in the rear pillar portion PR. The front pillar garnish 12 and the roof interior cover 13 are similar to those of the first embodiment, as shown in Figs. 27 to 29. Specifically, the garnish 12 and the roof interior cover 13 are mounted and fixed on the inner panel 7 of the front pillar body 4 and the roof side rail body 9 made of a sheet metal, respectively, by the mounting means (not shown). The garnish 12 and the roof interior cover 13 are provided with the door portions 12a and 13a, respectively, which are opened by the push of the airbag 220 when the airbag is inflated.

[0136] The rear pillar garnish 14 is made of a synthetic resin like the garnish 12. The garnish 14 is constructed, as shown in Figs. 27 and 30, to include a front panel portion 14a arranged on the front side and a rear panel portion 14b arranged on the rear side. These panel portions 14a and 14b are mounted and fixed by the means (not shown) on the rear pillar body 10 made of a sheet metal. In this rear pillar garnish 14, moreover, the rear panel 14b is provided with a door portion 14c on the front edge side. This door portion 14c covers the airbag 220 which is folded and accommodated. The door portion 14c is opened by the push of the airbag 220 when the airbag is inflated.

[0137] This airbag 220 is constructed, as shown in Figs. 31 to 34, to include an airbag body 221 and a belt portion 240. The airbag body 221 is formed into a flexible bag shape by the hollow-weaving method using polyamide yarns or the like. The belt portion 240 is made of a flexible woven fabric using polyamide yarns. The belt portion 240 is stitched to a front edge 232b of the airbag body 221.

[0138] The airbag body 221 comprises an inflating portion 222 and an uninflating portion 231. The inflating portion 222 is inflated, when fed with the inflation gas G from the inflator 18, to separate interior and exterior side wall portions 222a and 222b from each other (as shown in Fig. 34) thereby becoming wider. Moreover, the inflating portion 222 is developed from the folded state when

vided with a clearance between the rear edge of the central regulating portion 236 and the peripheral edge portion 232. This clearance is employed as an auxiliary inlet 227b capable of introducing the inflation gas G thereinto by the lower auxiliary inflating chamber 227. The auxiliary inlet 227b is provided so that the lower auxiliary inflating chamber 227 can be inflated more quickly than the upper auxiliary inflating chamber 226. Here, the opening area of the auxiliary inlet 227b is made smaller than that of the inlet 227a so that the main inflating chamber 225 inflates quickly over its whole length.

[0148] Moreover, a longitudinal rod portion 229 is arranged on the front end side of the inflatable portion 224. This longitudinal rod portion 229 is formed to have the upper and lower auxiliary inflating chambers 226 and 227 in the vicinities of the inlets 226a and 227a, and a front portion 225a of the front side chamber 225F. The longitudinal rod portion 229 is inflated into a substantially vertical column shape.

[0149] Moreover, the rear side of the upper edge 232a of the peripheral edge portion 232 and the rear extension regulating portion 235b form the upper and lower edges of the rear side chamber 225B. Also, the rear auxiliary inflating chamber 228 is provided with a clearance between the front end of the rear extension regulating portion 235b and the rear front extension regulating portion 235b. This clearance is employed as an inlet 228a for the inflation gas G by the rear auxiliary inflating chamber 228. In this embodiment, the rear front extension regulating portion 235d extends backward to below the front end of the rear extension regulating portion 235b. At the portion of the inlet 228a, therefore, the inflation gas G flowing in front of the rear side chamber 225B is reversed to flow into the rear auxiliary inflating chamber 228. Here, the rear lower extension regulating portion 235c regulates the width of the rear auxiliary inflating chamber 228 when fully inflated.

[0150] On the upper edge 232a of the peripheral edge portion 232, there are formed a plurality of mounting portions 238. Each of these mounting portions 238 is provided at its center with a mounting hole 238a for inserting the mounting bolt 46 thereinto. This mounting hole 238a is formed by boring the hollow-woven airbag body 221. On each mounting portion 238, moreover, there is fixed the mounting bracket 45, as shown in Figs. 27 to 29. By using the mounting brackets 45 and the bolts 46, the folded airbag 220 is fixed on the inner panel 7 and the roof side rail body 9 of the body 1. The mounting bolts 46 are inserted into the mounting holes 45c and 238a and screwed into the nuts 7b and 9b. These nuts 7b and 9b are fixed on the circumferential edges of the mounting holes 7a and 9a of the inner panel 7 and the roof side rail body 9.

[0151] In this embodiment, the belt portion 240 is stitched at its proximal portion 240a to the exterior face in the vicinity of the upper portion of the vertical edge 232c. The distal end portion 240b of the belt portion 240 is extended to the interior side through an insert hole 232d. In the airbag body 221, the insert hole 232d is arranged in the vicinity of the lower portion of the vertical edge 232c of the peripheral edge portion 232. The distal end portion 240b of the belt portion 240 is provided with a mounting hole 240c for inserting a bolt 241 (as shown in Fig. 27) thereinto. The distal end portion 240b is fixed on the side panel 2 of the body 1 by means of the bolt 241. The belt portion 240 is set to a predetermined length. Specifically, this length of the belt portion 240 establishes a forward tension on the side of a lower edge 221a of the airbag body 221 when the airbag 220 is inflated.

[0152] Moreover, the airbag 220 is folded in the bellows shape from the lower edge to the upper edge of the airbag 220 in the developed state. The folds Q are in parallel with the upper edge 232a of the peripheral edge portion 232, as shown in Fig. 32. After folding, moreover, the airbag body 221 is wound at a predetermined interval with a breakable tape so that it may not collapse.

[0153] Additionally, after the folding, the mounting brackets 45 are attached to the individual mounting portions 238. Moreover, the gas inlet portion 223 is unfolded, and the inflator 18 is inserted into the gas inlet portion 223. Then, the mounting bracket 15 is attached to the outer circumference of the gas inlet portion 223 to form the airbag assembly. In this state, the standby state is established for awaiting the mounting to the vehicle.

[0154] After this, the mounting bracket 15 is arranged at a predetermined position of the rear pillar body 10 and is fixed on the rear pillar body 10 by means of the bolts 16. The individual mounting brackets 45 are arranged at predetermined positions of the inner panel 7 and the roof side rail body 9 and are fixed on the inner panel 7 and the roof side rail body 9 by means of the bolts 46. The belt portion 240 is pulled out to fix its distal end portion 240b on the side panel 2 by means of the bolt 241. Moreover, the front pillar garnish 12, the roof interior cover 13 and the rear pillar garnish 14 are mounted on the body 1. As a result, the head-protecting airbag system M2 can be mounted to the vehicle.

[0155] When the inflator 18 is activated after the mounting to the vehicle, moreover, the inflation gas G flows from the inflator 18 through the gas inlet portion 223 into the main inflating chamber 225 of the inflatable portion 224. The inflation gas G further flows from the front side chamber 225F of the main inflating chamber 225 through the inlets 226a and 227a into the upper and lower auxiliary inflating chambers 226 and 227. The inflation gas G flows from the rear side chamber 225B of the main inflating chamber 225 through the inlet 228a into the rear auxiliary inflating chamber 228. As a result, the front and rear seat inflating portions 224a and 224b of the inflatable portion 224 are inflated. At this time, the breakable tape (not shown), wound on the airbag 220, breaks. Moreover, the individual door portions 12a, 13a and 14c of the rear panel portion 14b in the front pillar

bag body 221 by the [redacted]portion 240.

[0163] Here, the airbag 220 in accordance with the fifteenth embodiment has been described in the case in which the upper and lower auxiliary inflating chambers 226 and 227 are individually provided by one chamber. However, the upper and lower auxiliary inflating chambers 226 and 227 may be divided by providing an extension regulating portion or a central regulating portion suitably. Likewise, the rear auxiliary inflating chamber 228 may also be divided into three or more chambers by providing the extension regulating portion 235 and the central regulating portion 236 of the uninflating portion 231 and so on suitably.

[0164] When the airbag is to be formed by the hollow-weaving method using warps and wefts, moreover, it may be constructed and arranged like airbag 320 of a sixteenth embodiment shown in Figs. 35 to 38. Specifically, a main inflating chamber 325 of the airbag 320 is arranged substantially in parallel with warps V or wefts H. The airbag 320 is folded on folds along the main inflating chamber 325.

[0165] The airbag 320 of the sixteenth embodiment is a head protecting airbag system M3. The airbag 320 is arranged in a folded shape on the upper edge portion of the opening W of the door or window on the interior side. Specifically, the airbag 320 is folded and arranged from the front pillar portion PF to the roof side rail portion R.

[0166] The head-protecting airbag system M3 is constructed, as in the first embodiment, to include the airbag 320, the inflator 18, the mounting bracket 15 and the airbag cover 11. Of these, the inflator 18, the mounting bracket 15 and the airbag cover 11 are similar to those of the first embodiment, and their description will be omitted.

[0167] The airbag 320 is constructed, as shown in Figs. 38 to 41, to include an airbag body 321 and a belt portion 340. The airbag body 321 is formed into a flexible bag shape. This airbag body 321 is formed by the hollow-weaving method. This hollow-weaving method employs polyamide yarns or the like as the warps V and the wefts H (as should be referred to an enlarged portion showing the encircled texture of Fig. 38). The belt portion 340 is stitched to a rear edge 332a of the airbag body 321. The belt portion 340 is made of a flexible woven fabric using polyamide yarns or the like.

[0168] The airbag body 321 comprises an inflating portion 322 and an uninflating portion 331. The inflating portion 322 separates, when fed with the inflation gas from the inflator 18, interior or exterior side wall portions 322a and 322b (as shown in Fig. 41) from each other. In other words, the inflating portion 322 is inflated to become thicker when fed with the inflation gas. By this inflation gas thus fed, the inflating portion 322 is inflated from the folded state. The uninflating portion 331 neither admits the inflation gas nor becomes wider. Here, the airbag body 321 may be coated on its surface with silicone or the like after the individual portions 322 and 331 were hollow-woven. This coating is made to improve the heat resistance and the sealing properties.

[0169] The inflating portion 322 comprises a gas inlet portion 323 and an inflatable portion 324. The gas inlet portion 323 is arranged on the front end side of the inflatable portion 324 to introduce the inflation gas into the inflatable portion 324. The inflatable portion 324 extends backward in communication with the gas inlet portion 323. The inflatable portion 324 is formed in the bag shape and is inflated to cover the opening W on the interior side.

[0170] The gas inlet portion 323 is formed in a longitudinal (fore and aft) extending cylinder shape opened on the front end side. The inflator 18 is inserted into the gas inlet portion 323 from the front end side. And, the gas inlet portion 323 is clamped on the inflator 18 by the mounting bracket 15. As a result, the gas inlet portion 323 is joined to the inflator 18. Here, an inner tube may be fixed on the inner circumference of the gas inlet portion 323 so as to retain the heat resistance. This inner tube is made of the same material as that of the airbag body 321 itself.

[0171] The inflatable portion 324 comprises the main inflating chamber 325 and upper and lower auxiliary inflating chambers 326 and 327. The main inflating chamber 325 extends straight backward from the gas inlet portion 323. The main inflating chamber 325 is arranged substantially in parallel with the wefts H of the texture of the airbag body 321. The upper and lower auxiliary inflating chambers 326 and 327 communicate with a rear portion 325a of the main inflating chamber 325. Also, the upper and lower auxiliary inflating chambers 326 and 327 are arranged over and below the main inflating chamber 325, respectively.

[0172] The uninflating portion 331 is so woven that the interior wall portion 322a and the exterior wall portion 322b of the airbag body 321 are joined. The uninflating portion 331 comprises a peripheral edge portion 332 and a regulating portion 334. The peripheral edge portion 332 is arranged on the outer circumference edges of the gas inlet portion 323 and the inflatable portion 324. The peripheral edge portion 332 is so densely woven as to prevent gas leaks. The regulating portion 334 comprises an upper regulating portion 335, a lower regulating portion 336 and an upper auxiliary regulating portion 337. The upper and lower regulating portions 335 and 336 extend backward from the front side of the peripheral edge portion 332 into the region of the inflatable portion 324. The upper auxiliary regulating portion 337 is arranged over the upper regulating portion 335 and in parallel with the upper regulating portion 335. The upper auxiliary regulating portion 337 regulates the width of the upper auxiliary inflating chamber 26 when fully inflated.

[0173] The upper regulating portion 335 and the lower regulating portion 336 regulate the upper and lower edges 325b and 325c of the main inflating chamber 325. And, a lower edge 335b of the upper regulating

hole (not shown) of th[illegible]er panel 7 or the roof side rail body 9. Next, as shown in Figs. 36 and 37, the mounting bolt 351 is inserted into the mounting holes 348a, 338a and 349a and screwed into the nuts 7b and 9b. As a result, the folded airbag 320 is mounted to the body 1.

[0181] The belt portion 340 is trifurcated in this embodiment to have mounting member portions 341, 342 and 343. These mounting member portions 341, 342 and 343 are joined at an intersection 340a. And, the end portions of the mounting member portions 341 and 342, that is, the proximal portions 340b and 340c of the belt portion 340 are stitched to the circumferential edge of the longitudinal rod portion 329. Specifically, the proximal portions 340b and 340c are stitched over and below the rear edge 332a of the airbag body 321. The leading end of the mounting member portion 343, that is, the distal end portion 340d of the belt portion 340 is provided with a mounting hole 343a and two through holes 343b. The mounting bracket 347 is attached, after the airbag 320 is folded up, to the distal end portion 340d. The distal end portion 340d is attached like the mounting portion 338 to the roof side rail body 9 by means of the bolts 351.

[0182] Here, the belt portion 340 is set to a predetermined length. Specifically, the length of the belt portion 340 is set to apply the backward tension F (as shown in Fig. 40) to a lower portion 321a of the airbag body 321 when the airbag 320 is inflated after being mounted to the vehicle.

[0183] The airbag 320 is folded in the bellows shape from the lower edge to the upper edge of its developed state. The folds Q of this bellows shape extend along the main inflating chamber 325, as shown in Fig. 39. After the folding the airbag 320, moreover, the airbag body 321 is wound at a predetermined interval with a breakable tape so that it may not collapse.

[0184] After the folding the airbag 320, the mounting member portion 343 of the belt portion 340 is pulled out. On the other hand, the mounting portion 338 on the front side is also pulled out. And, the mounting brackets 347 are attached to the distal end portion 340d of the mounting member portion 343 and all the mounting portions 338. Moreover, the gas inlet portion 323 is pulled out. Next, the inflator 18 is inserted into the gas inlet portion 323. Moreover, the mounting bracket 15 is attached to the outer circumference of the gas inlet portion 323 to form the airbag assembly.

[0185] The retaining member 348d of each mounting bracket 347 is retained on the circumferential edge of the retaining holes (not shown) of the inner panel 7 and the roof side rail body 9. On the other hand, the mounting bracket 15 is arranged at a predetermined position of the side panel 2 and is fixed on the side panel 2 by using the bolts 16. By using the bolts 351, each mounting bracket 347 is fixed on the inner panel 7 or the roof side rail body 9. Still moreover, the pillar garnish 12 and the roof interior cover 13 are mounted on the body 1. As a result, the head protecting airbag system M3 can be mounted to th[illegible]icle.

[0186] Now, when the airbag 320 is mounted to the vehicle, the gas inlet portion 323 is slightly bent to lower the front end side (as shown in Figs. 35 and 40). Specifically, the gas inlet portion 323 leads straight to a forward downsloping front portion 332cF of the upper edge 332c of the peripheral edge portion 332. This front portion 332cF is arranged in the front pillar portion PF.

[0187] When the inflator 18 is activated after the mounting on the vehicle, the inflation gas G is fed from the inflator 18 through the gas inlet portion 323 to the inflatable portion 324, and the airbag 320 breaks the tape wound thereon (not shown). On the other hand, the airbag 320 pushes the pillar garnish 12 or the roof interior cover 13 to open their individual door portions 12a and 13a. The airbag 320 is inflated to such a size as to cover the opening W, as shown by the double-dotted lines in Figs. 35 to 37.

[0188] In the airbag 320 in accordance with the sixteenth embodiment, at the initial inflow of the inflation gas G, as shown in Figs. 38 and 40, the inflation gas G flows through the gas inlet portion 323 into the main inflating chamber 325 of the inflatable portion 324. Moreover, the inflation gas G flows from the rear portion 325a of the main inflating chamber 325 through the inlets 326a and 327a into the upper and lower auxiliary inflating chambers 326 and 327. The airbag 320 is fully inflated when the inflation gas G flows into the upper and lower auxiliary inflating chambers 326 and 327.

[0189] In the sixteenth embodiment, too, the main inflating chamber 325 is inflated before the upper and lower auxiliary inflating chambers 326 and 327. The main inflating chamber 325 extends straight backward from the gas inlet portion 323. Therefore, the main inflating chamber 325 is quickly inflated. On the other hand, the main inflating chamber 325 is arranged lengthwise in the longitudinal (fore and aft) direction at the vertically intermediate portion of the upper and lower auxiliary inflating chambers 326 and 327, that is, at the vertically intermediate portion of the inflatable portion 324. In short, the main inflating chamber 325 is arranged lengthwise in the fore and aft direction at the vertically intermediate portion of the inflatable portion 324. As a result, the main inflating chamber 325 is inflated over a wide area.

[0190] As a result, the airbag 320 of the sixteenth embodiment can inflate the main inflating chamber 325 quickly and widely before the inflation is completed. With this area of the main inflating chamber 325, moreover, the airbag 320 can restrict the passenger properly quickly and over a wide area before the airbag is fully inflated.

[0191] when fully inflated, the lower edge 321a of the airbag body 321 is pulled backward, as shown in Fig. 40, by the belt portion 340.

[0192] In the airbag 320 in accordance with the sixteenth embodiment, moreover, the airbag body 321 is formed by the hollow-weaving operation using the

bag may be constructed in this way. Alternatively, the front side of the upper and lower edges 325b and 325c on the side of the gas inlet portion 323 is in parallel with the warps V or the wefts H. Moreover, a nonparallel portion such as a taper or step may be formed on the rear side of the upper and lower edges 325b and 325c spaced from the gas inlet portion 323. The airbag may be constructed in this way. It is quite natural that the upper and lower edges 325b and 325c may be in parallel over their entire lengths with the warps V or the wefts H.

[0201] Here, the nonparallel portion, which is not in parallel with the warps V or the wefts H, is to be formed on at least one of the upper edge 325b and the lower edge 325c, in the following manner. Specifically, the nonparallel portion is formed apart from a portion 325F (as shown in Fig. 39) adjoining the gas inlet portion 323. This is because the inflator 18 is inserted into the gas inlet portion 323. If the nonparallel portion is formed at the portion 325F adjoining the gas inlet portion 323, moreover, the high pressure at the initial inflow of the inflation gas G acts on that portion 325F, and a gas leak is liable to occur at the portion 325F.

[0202] Moreover, the airbag 320 in accordance with the sixteenth embodiment has been described in the case in which the gas inlet portion 323 is arranged on the front side of the inflatable portion 324. However, the longitudinal (fore and aft) direction of the airbag may be inverted. For example, the airbag may be arranged from the rear pillar portion to the roof side rail portion R of the vehicle. In this modification, moreover, the inflatable portion may be constructed to cover the side portions of the front seat and the rear seat when the airbag is fully inflated.

[0203] The foregoing detailed description of the preferred embodiments of this invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise embodiments disclosed. Obviously, many modifications and variations may be evident to practitioners in the art when considered in reference to the disclosure. The embodiments were chosen and explained in order to best describe the principles of this invention and its practical applications, thereby enabling others skilled in the art to understand the invention for various embodiments and with various modifications as are suited for the particular use contemplated.

[0204] An airbag for a head protecting airbag system is adapted to be folded up and accommodated along an upper interior edge of a vehicle and to be developed and inflated to cover an interior opening of the vehicle. The airbag comprises a flexible airbag body and a flexible belt portion. The airbag body includes an inflatable portion adapted to be inflated to cover the interior opening when the airbag is inflated. The inflatable portion includes a longitudinal rod portion adapted to be inflated substantially vertically into a column shape. The longitudinal rod portion is arranged on one end side of the front end side or the rear end side of the inflatable portion. The belt portion is joined at its proximal portion to the peripheral edge of the longitudinal rod portion and is fixed at its distal end portion on the vehicle. When the airbag body is inflated, the lower end side of the longitudinal rod portion may be turned on the upper end side of the longitudinal rod portion in the forward or backward direction away from the inflatable portion. Thus, a high tension is established on the lower edge of the airbag body.

Claims

1. An airbag for a head-protecting airbag system of a vehicle having an interior compartment constructed and arranged to accommodate a vehicle operator or at least one passenger, said airbag being receivable in the vehicle along an upper interior edge thereof which defines a portion of the interior compartment, said airbag comprising a flexible airbag body and a flexible belt,
   wherein said airbag body has an inflatable portion which, upon inflation, enters the interior compartment and covers the upper interior edge of the vehicle;
   characterized in

   that said airbag body includes a longitudinally extending rod portion inflatable into a substantially vertically oriented column, said rod portion being arranged forward or rear of said inflatable portion; and
   that said flexible belt connects at a proximal end thereof to a peripheral edge of said rod portion and connects at a distal end thereof to the vehicle so that, upon inflation of said inflatable portion, said flexible belt guides said rod portion to generally pivot about an end thereof into a substantially vertical orientation.

2. An airbag for a head-protecting airbag system as set forth in claim 1,
   wherein said flexible belt has a length when extended straight between proximal and distal ends thereof which is shorter than a distance between the proximal end and the distal end when the distal end is fixed on the vehicle when the airbag is mounted to the vehicle but uninflated.

3. An airbag for a head-protecting airbag system as set forth in claim 1,
   wherein said flexible belt is joined at its proximal portion to a circumferential edge of an upper end portion of the longitudinal rod portion and fixed at its distal end to the vehicle through an insert hole defined in a circumferential edge of a lower end portion of the longitudinal rod portion.

12. An airbag for a head-protecting airbag system as set forth in claim 11,
wherein said flexible belt portion is arranged on an exterior face of the cover portion.

13. An airbag for a head-protecting airbag system as set forth in claim 11,
wherein said cover portion is formed integrally with the uninflating portion.

14. An airbag for a head protecting airbag system as set forth in claim 7,
wherein said inflatable portion includes front and rear seat inflating portions arranged proximally to the sides of a front vehicle seat and a rear vehicle seat, respectively, when being inflated,
wherein said gas inlet portion is arranged on a back side of the inflatable portion,
wherein said main inflating chamber is arranged substantially straight forward from the gas inlet portion,
wherein said front seat inflating portion includes:

a front side chamber on a front portion of the main chamber; and
upper and lower auxiliary chambers arranged over and below the front side chamber, respectively, in communication with the front end side of the front side chamber, and

wherein said rear seat inflating portion includes:

a rear side chamber on the rear side of the main chamber; and
a rear auxiliary inflating chamber communicating with the rear side chamber.

15. An airbag for a head-protecting airbag system as set forth in claim 14,
wherein said upper and lower auxiliary chambers of the front seat inflating portion include individual inlets communicating with a front end side of the front side chamber for introducing inflation gas thereinto,
wherein said lower auxiliary chamber includes an auxiliary inlet formed on a rear side of the lower auxiliary chamber and communicating with the main chamber for introducing the inflation gas thereinto, and
wherein the opening area of the auxiliary inlet is smaller than that of the inlet of the front side of the lower auxiliary chamber.

16. An airbag for a head-protecting airbag system as set forth in claim 14,
wherein said rear auxiliary inflating chamber includes an inlet communicating with the rear side chamber for introducing the inflation gas thereinto, and
wherein a portion of said inlet is constructed to reverse the flow of the inflation gas passing forward through the rear side chamber, thereby introducing gas into the rear auxiliary inflating chamber.

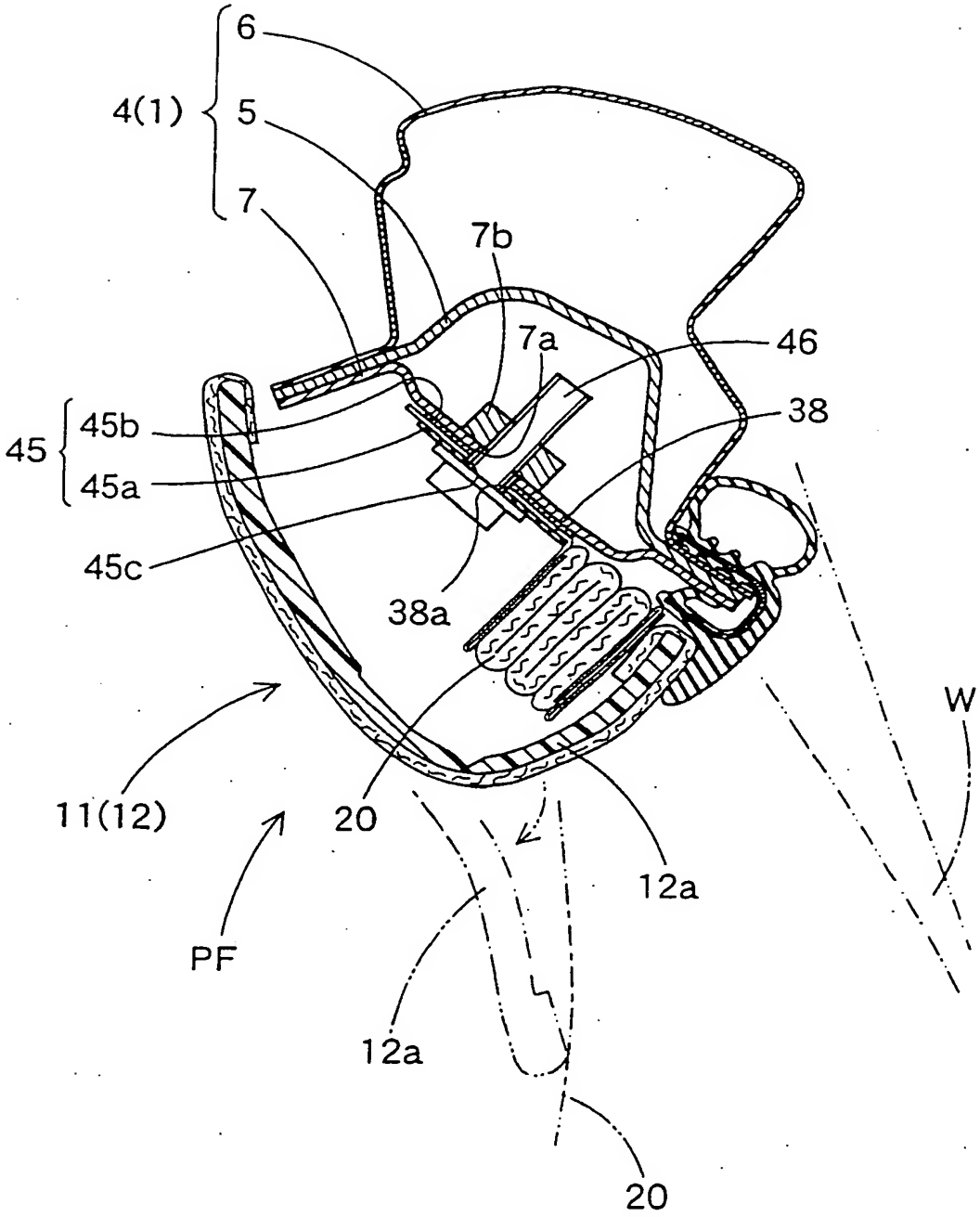
17. An airbag for a head-protecting airbag system as set forth in claim 7,
wherein said airbag is formed by a hollow-weaving method using warps and wefts,
wherein said main inflating chamber is arranged substantially in parallel with the at lest one of warps and wefts, and
wherein said airbag is folded on folds along the main inflating chamber.

18. An airbag for a head-protecting airbag system as set forth in claim 17,
wherein approximately 50% or more of a total length of an upper edge and a lower edge of the main inflating chamber is formed in parallel with the at least one of warps and wefts.

19. An airbag for a head-protecting airbag system as set forth in claim 17,

further comprising:
an inflator inserted into the gas inlet portion for feeding the inflation gas,
wherein a nonparallel portion, not in parallel with the at least one warps and wefts, is formed on at least one of the upper edge and the lower edge of the main chamber, and
wherein said nonparallel portion is formed spaced from the gas inlet portion, in which the inflator is inserted.

Fig. 2



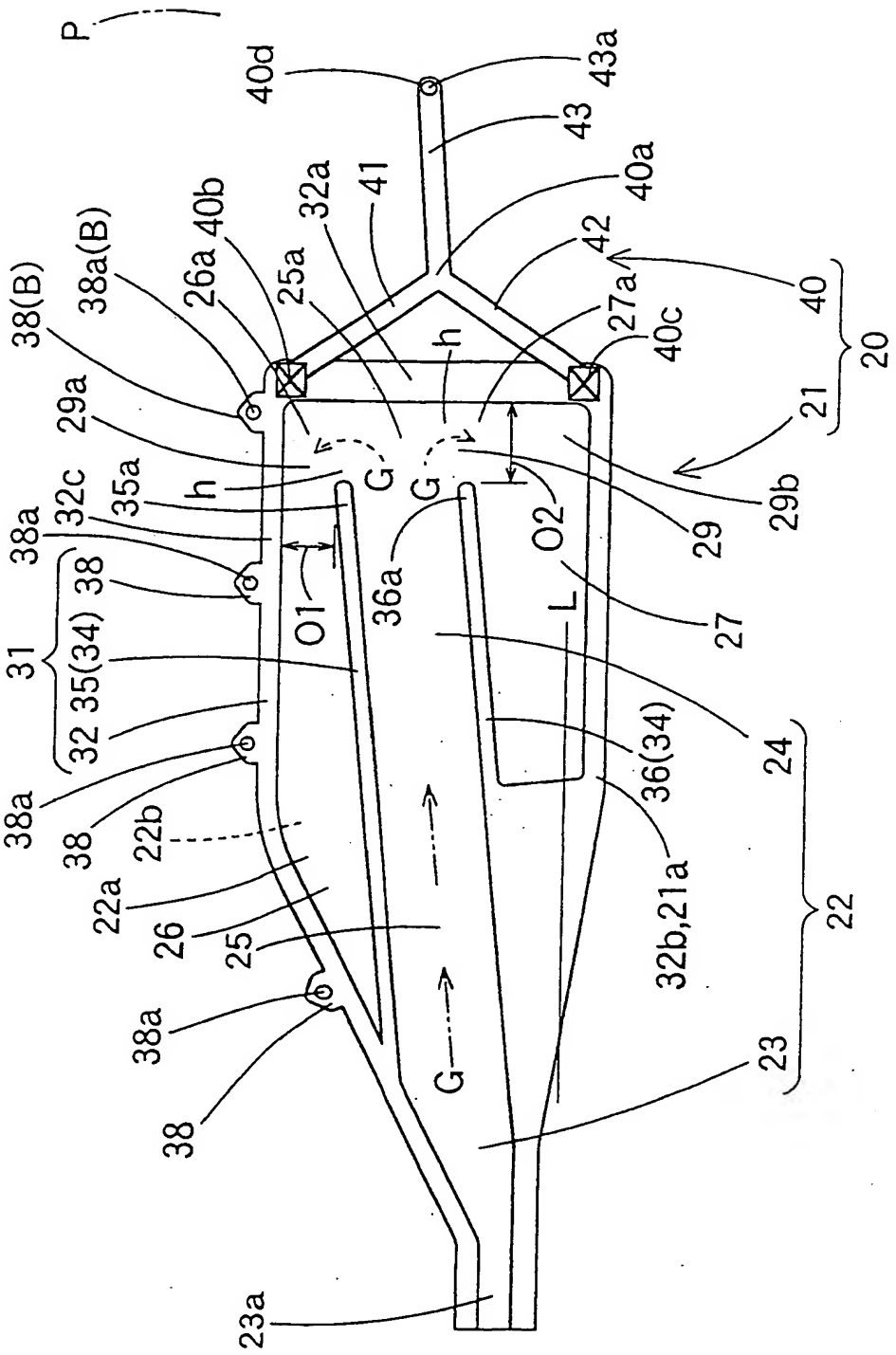

P
40d
43a
43
40a
41
32a
40b
26a
25a
38a(B)
38(B)
42
27a
40
40c
20
21
29a
h
G
G
29b
29
32c
35a
38a
38
31
35(34)
32
O1
36a
O2
L
27
24
36(34)
22b
22a
26
25
38a
38
32b,21a
22
23
G
23a

Fig. 4

Fig.6

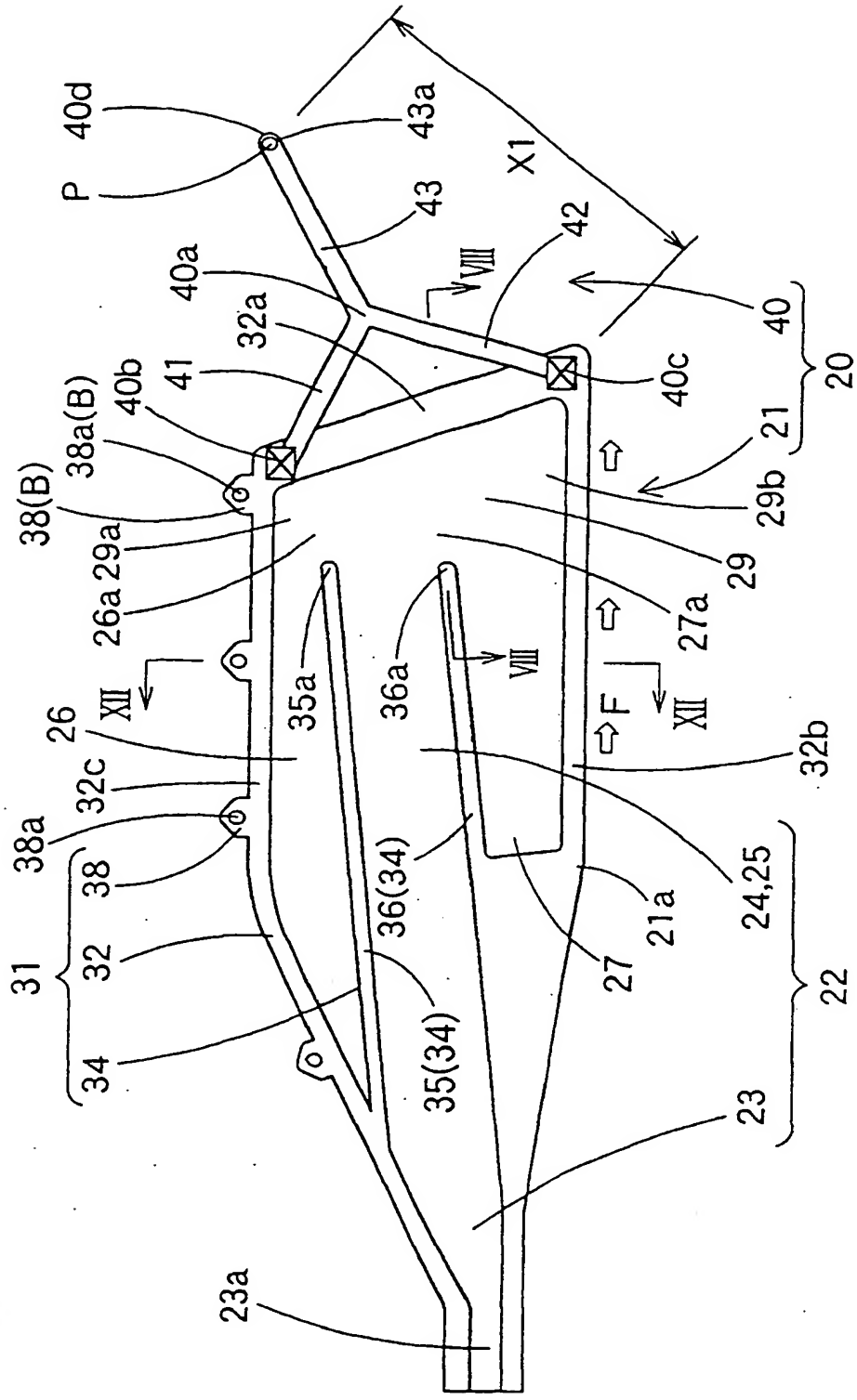
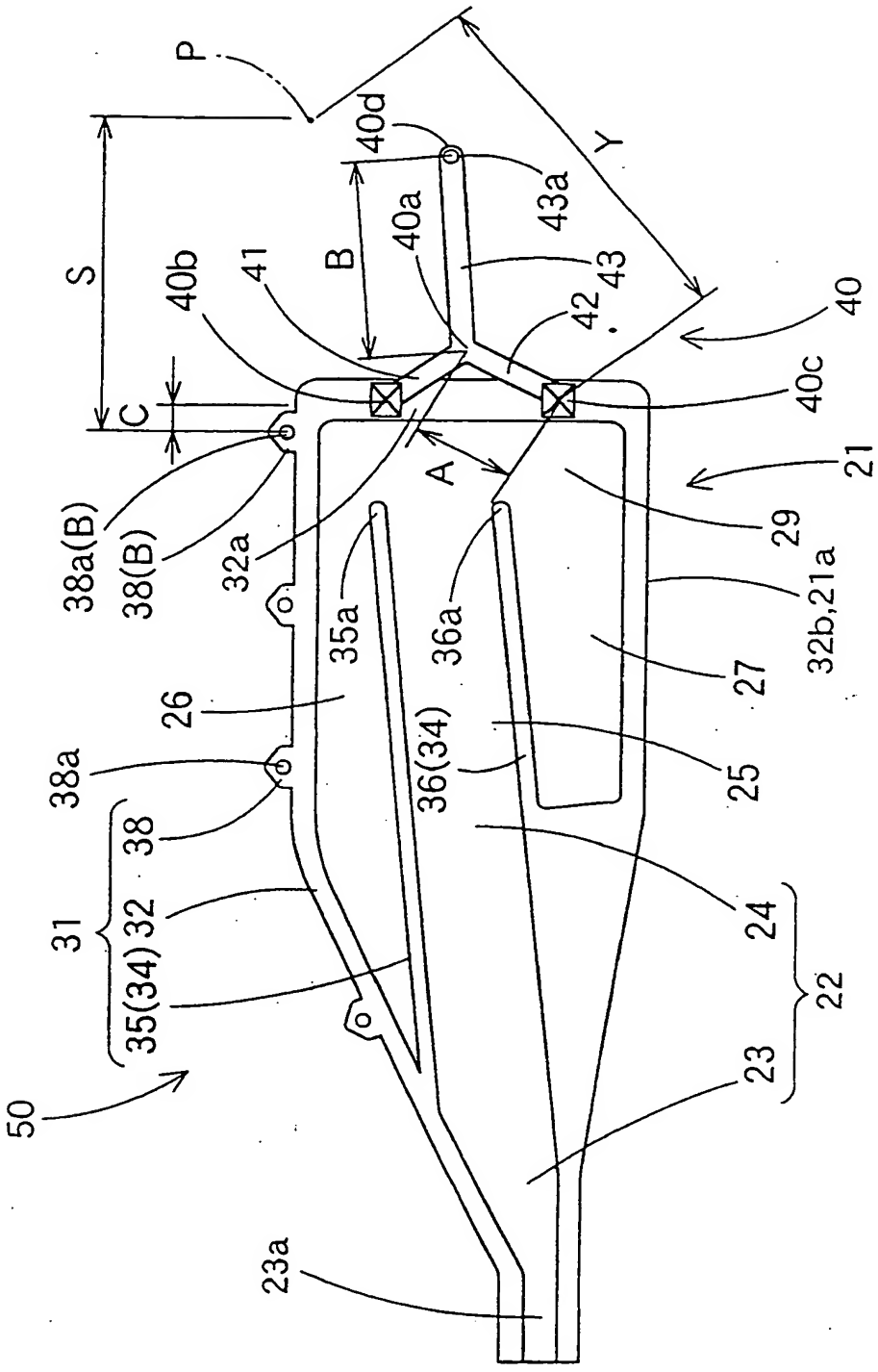

P
40d
43a
X1
43
42
40a
VIII
32a
40
41
40b
40c
20
38a(B)
21
38(B)
29b
29a
29
26a
27a
VIII
XII
F
XII
35a
36a
26
32b
32c
38a
24,25
38
36(34)
21a
31
32
27
22
35(34)
34
23
23a

Fig.9


P
S
C
B
A
Y
40d
40a
43a
43
42
40
40b
41
40c
21
29
32b,21a
27
25
24
22
23
23a
50
31
35(34)
32
38
38a
26
36(34)
36a
35a
32a
38(B)
38a(B)

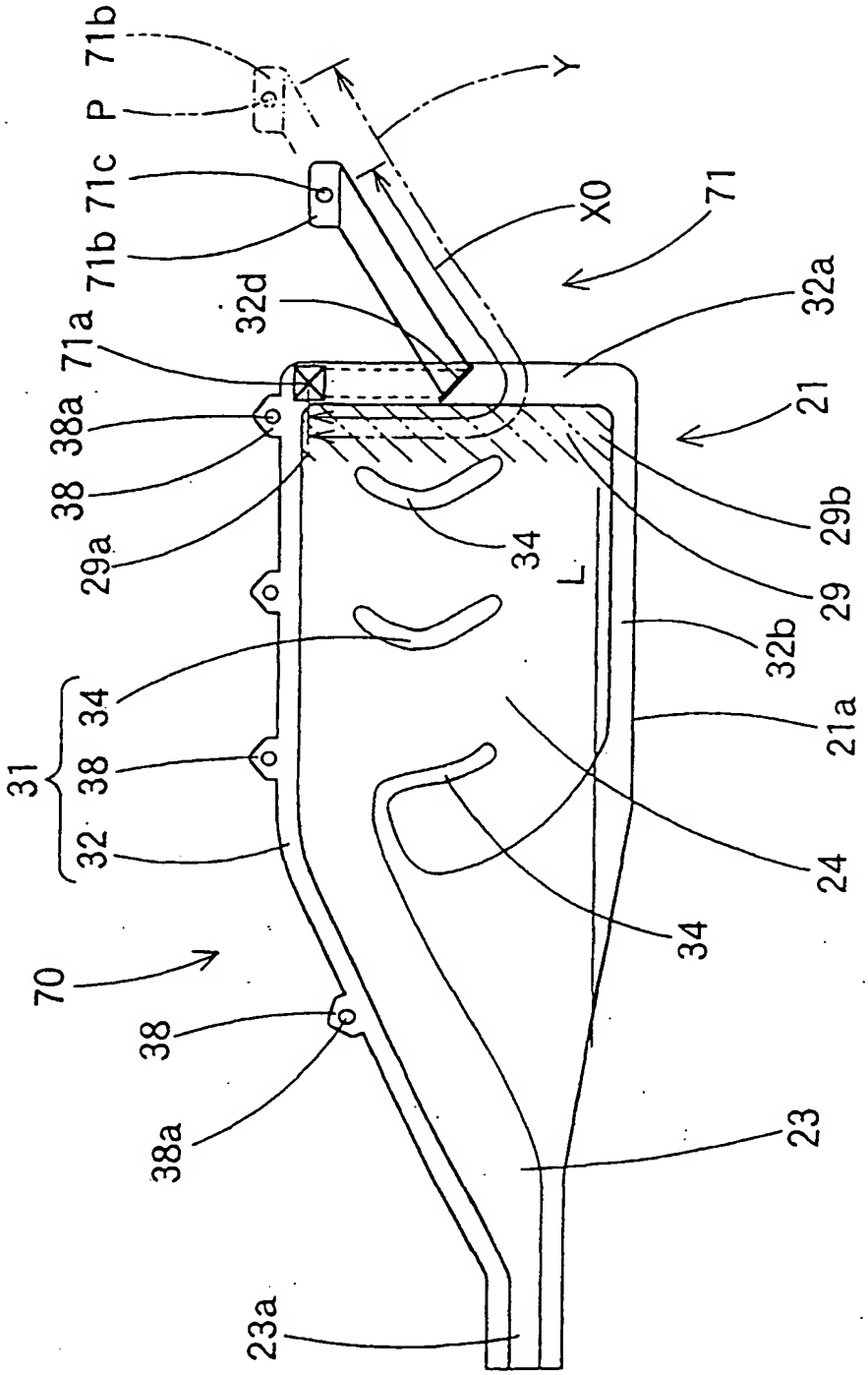

71b
P
71c
71b
71a
38a
38
29a
32d
Y
X0
71
32a
21
29b
29
34
L
32b
21a
24
34
23
23a
38a
38
70
31
32
34
38
34

Fig. 11

Fig.13

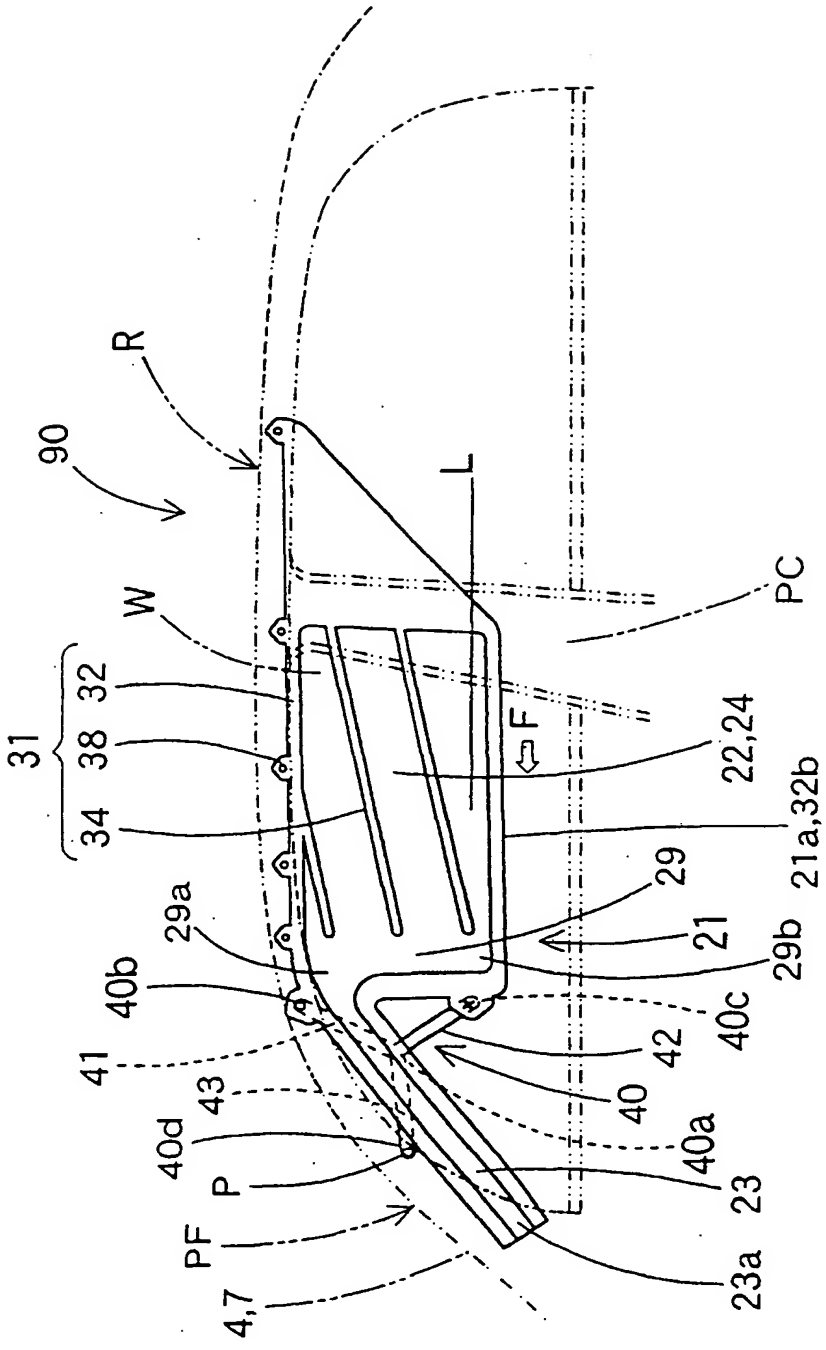
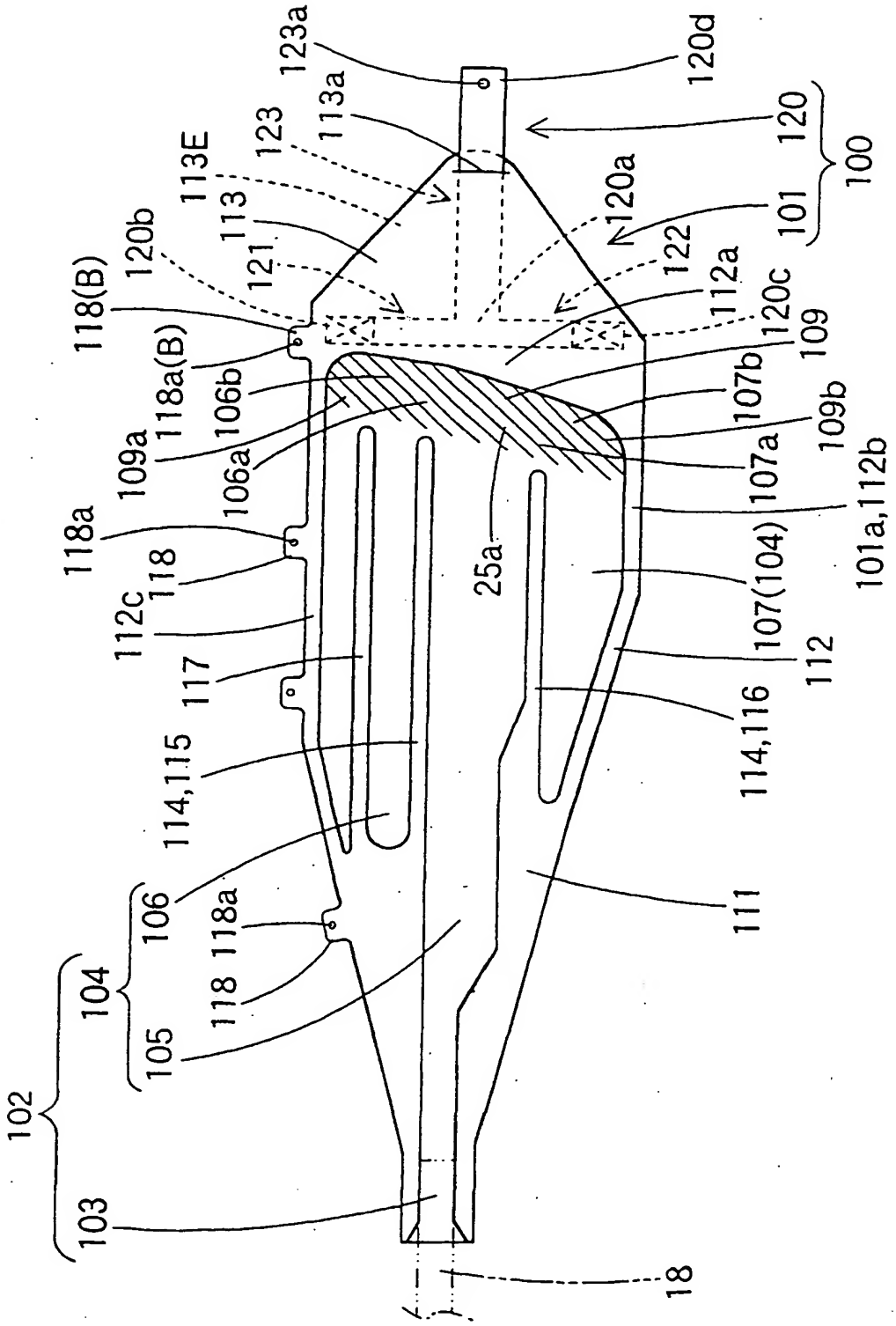

R
90
W
L
PC
31
32
38
34
F
22,24
21a,32b
29
29a
21
29b
40b
40c
41
42
43
40
40d
40a
P
23
PF
23a
4,7

Fig. 15


123a
120d
113a
123
120
113E
120a
100
113
101
120b
121
122
118(B)
112a
120c
109
118a(B)
106b
107b
109a
106a
109b
107a
118a
25a
101a,112b
118
112c
107(104)
117
112
114,115
114,116
106
111
118a
118
104
105
102
103
18

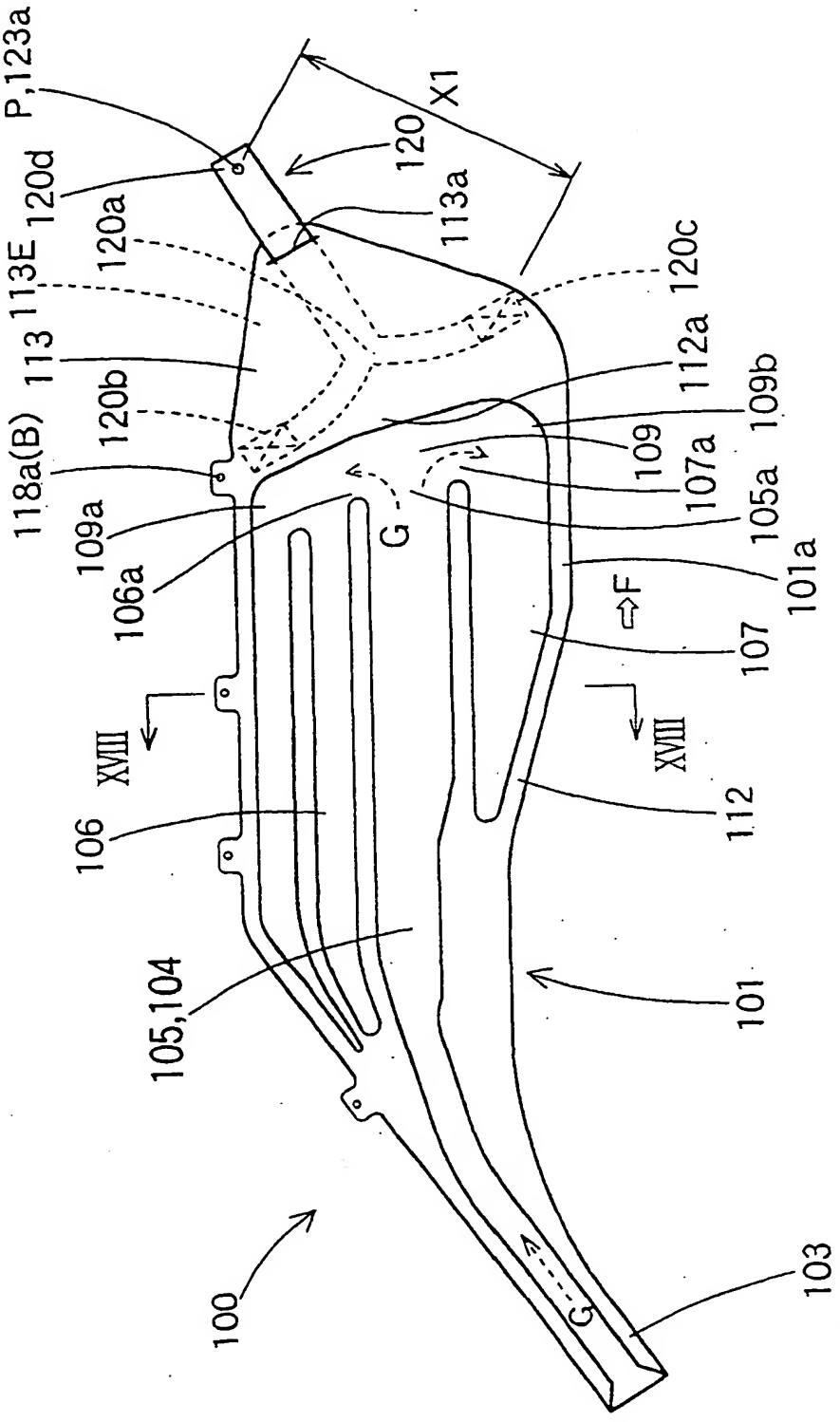

P,123a
X1
120
120d
113a
120a
113E
120c
113
112a
120b
109b
118a(B)
109
107a
109a
105a
G
106a
101a
F
107
XVIII
XVIII
106
112
105,104
101
100
G
103

Fig. 17

Fig. 19

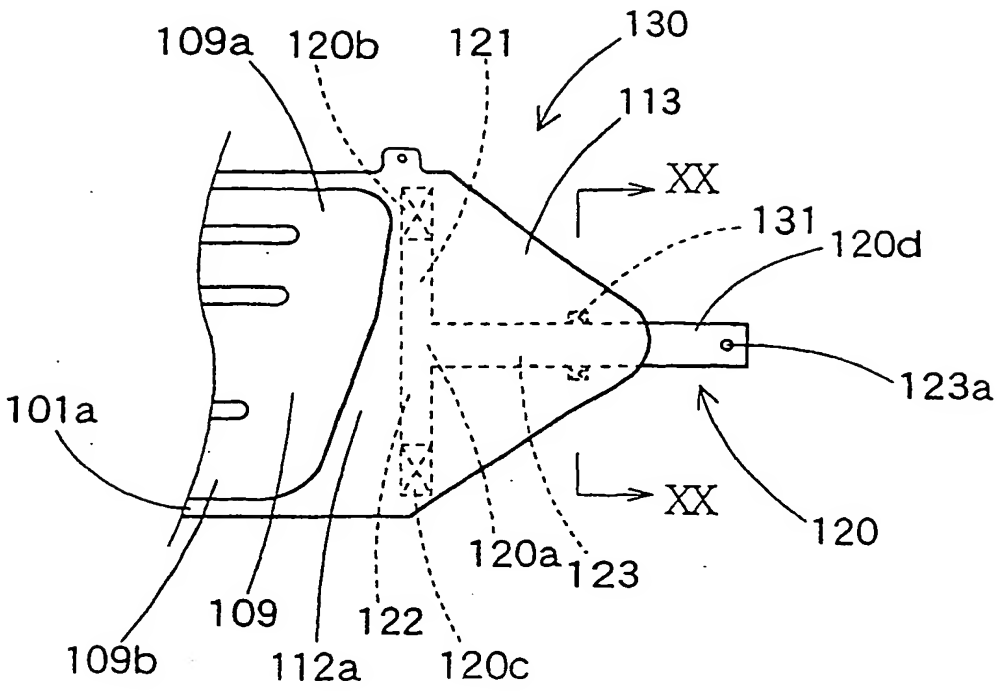
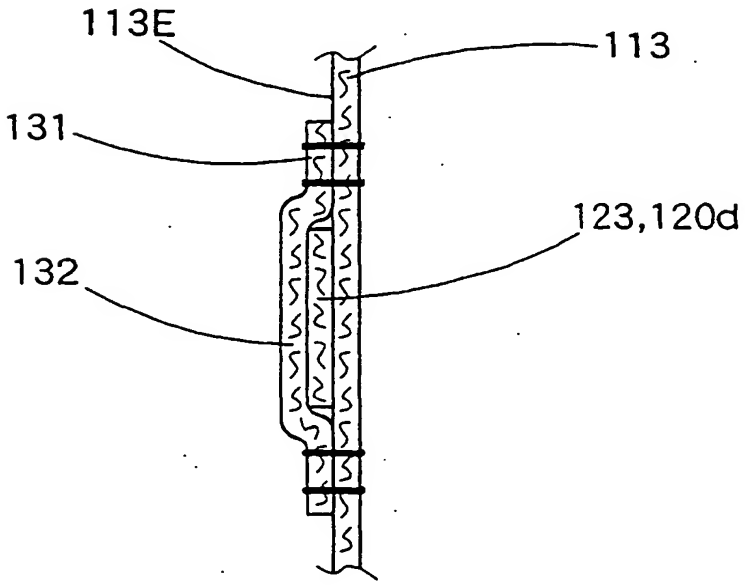

109a
120b
121
130
113
XX
131
120d
123a
101a
XX
120
120a
123
109
122
109b
112a
120c

Fig. 20


113E
113
131
123,120d
132

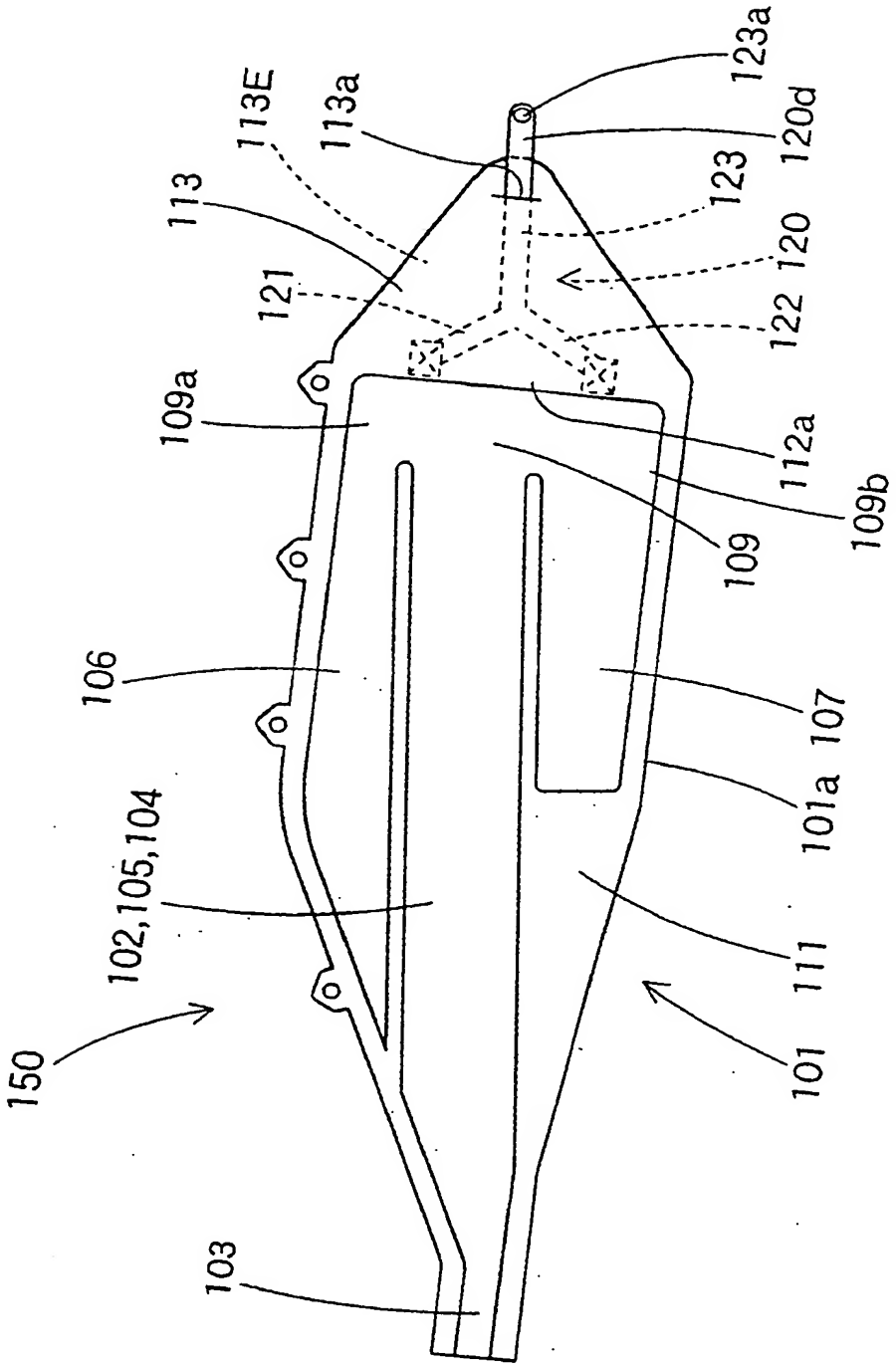

123a
120d
113E
113a
123
113
120
121
122
109a
112a
109b
109
106
107
101a
102,105,104
111
150
101
103

Fig. 22

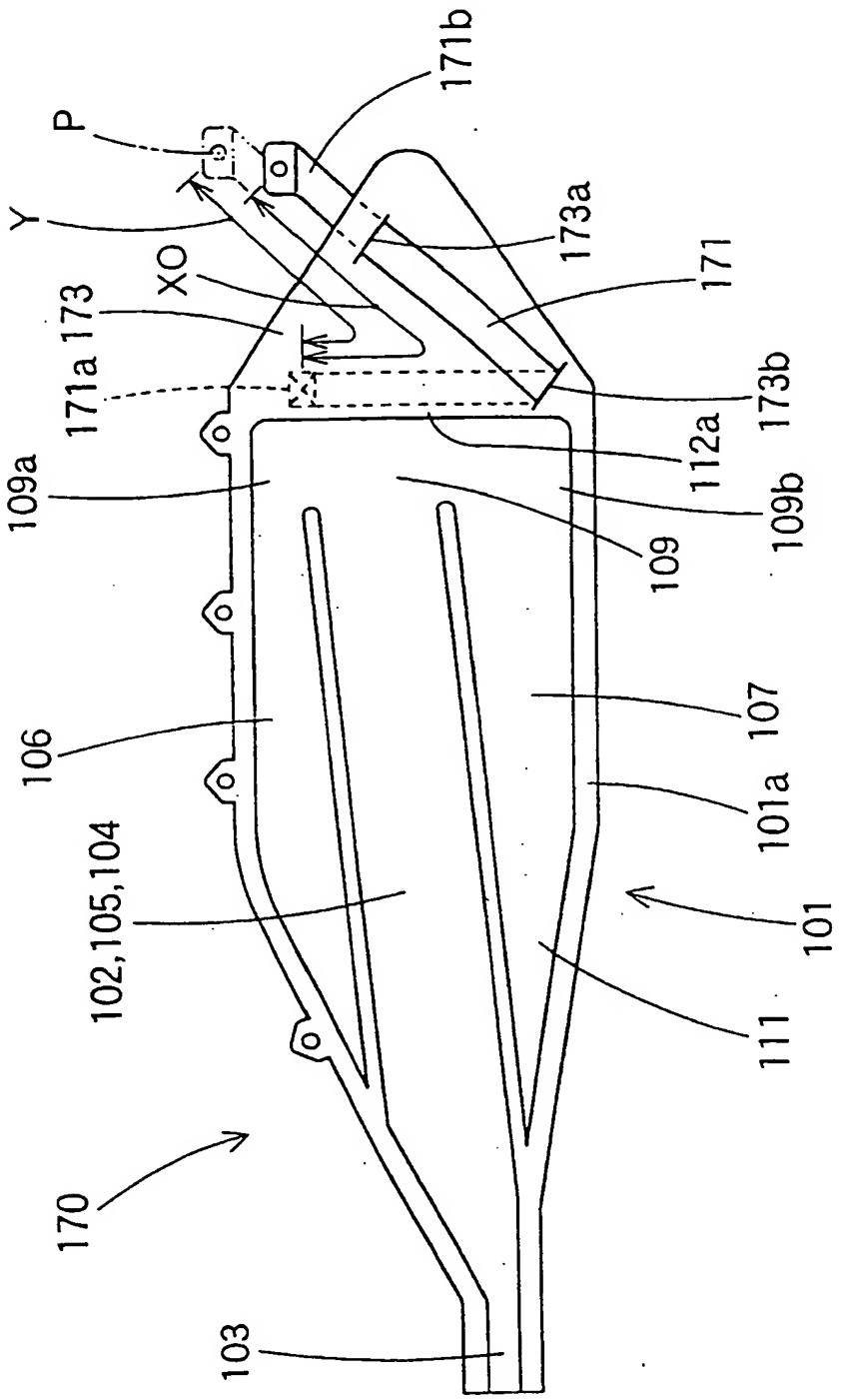

171b
P
Y
XO
173
171a
109a
106
102,105,104
170
103
173a
171
173b
112a
109b
109
107
101a
101
111

Fig.24

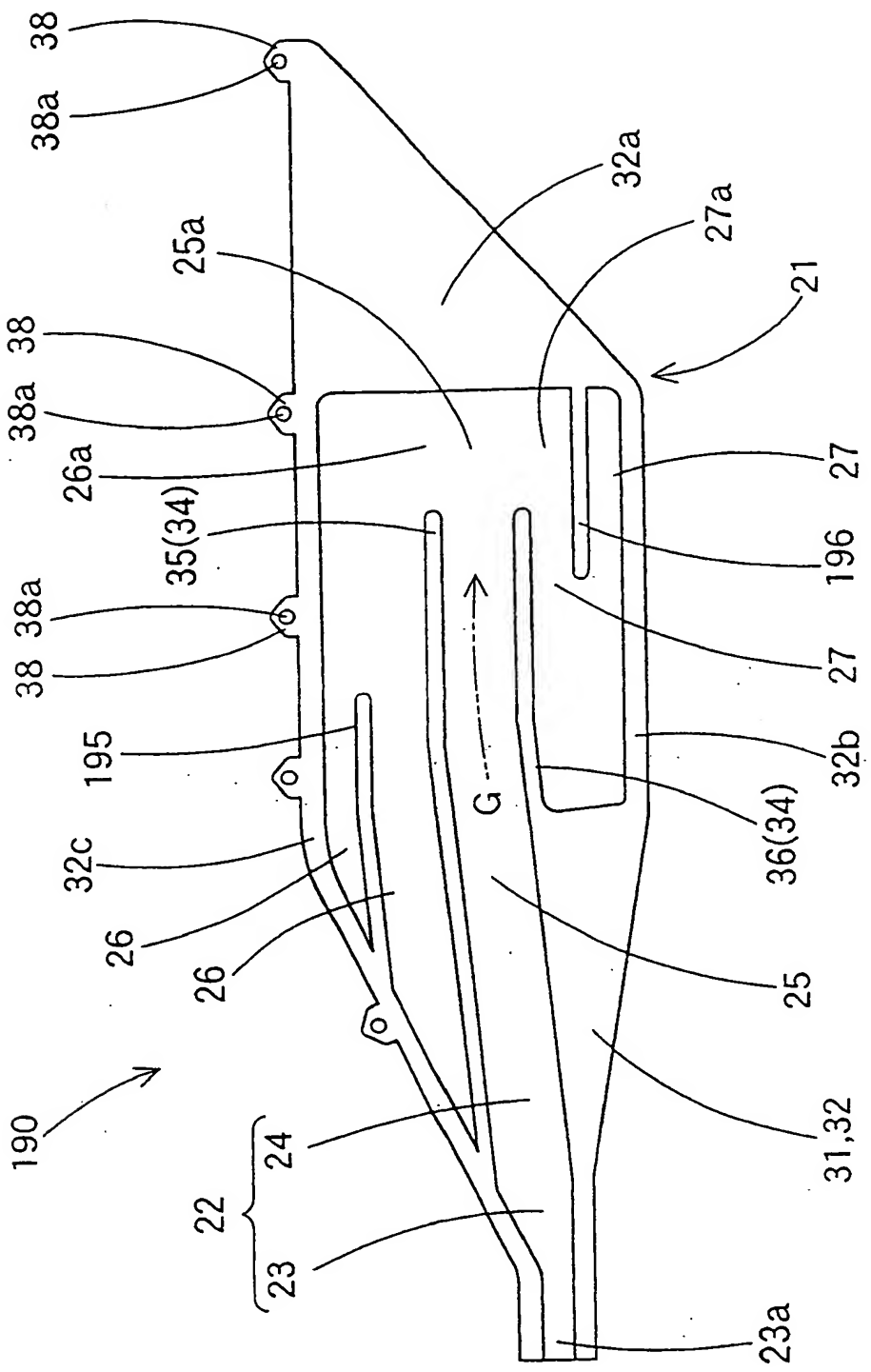

38
38a
25a
32a
27a
21
38
38a
26a
35(34)
27
196
38a
38
27
195
32b
G
36(34)
32c
26
26
25
190
31,32
22
24
23
23a

Fig.26

Fig. 28

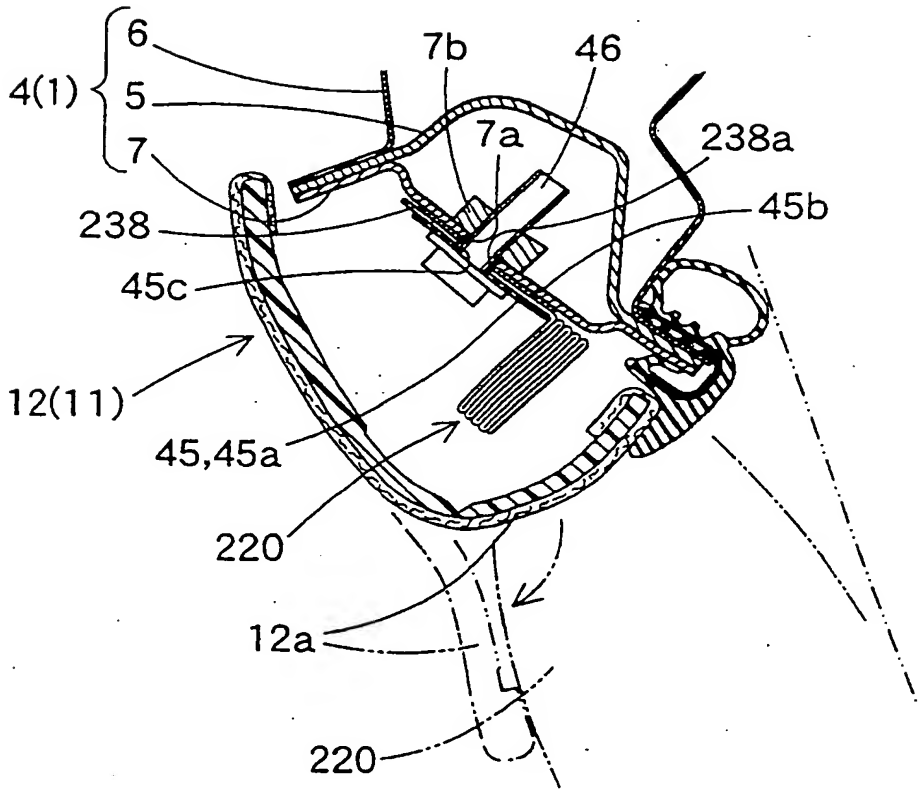


Fig. 31

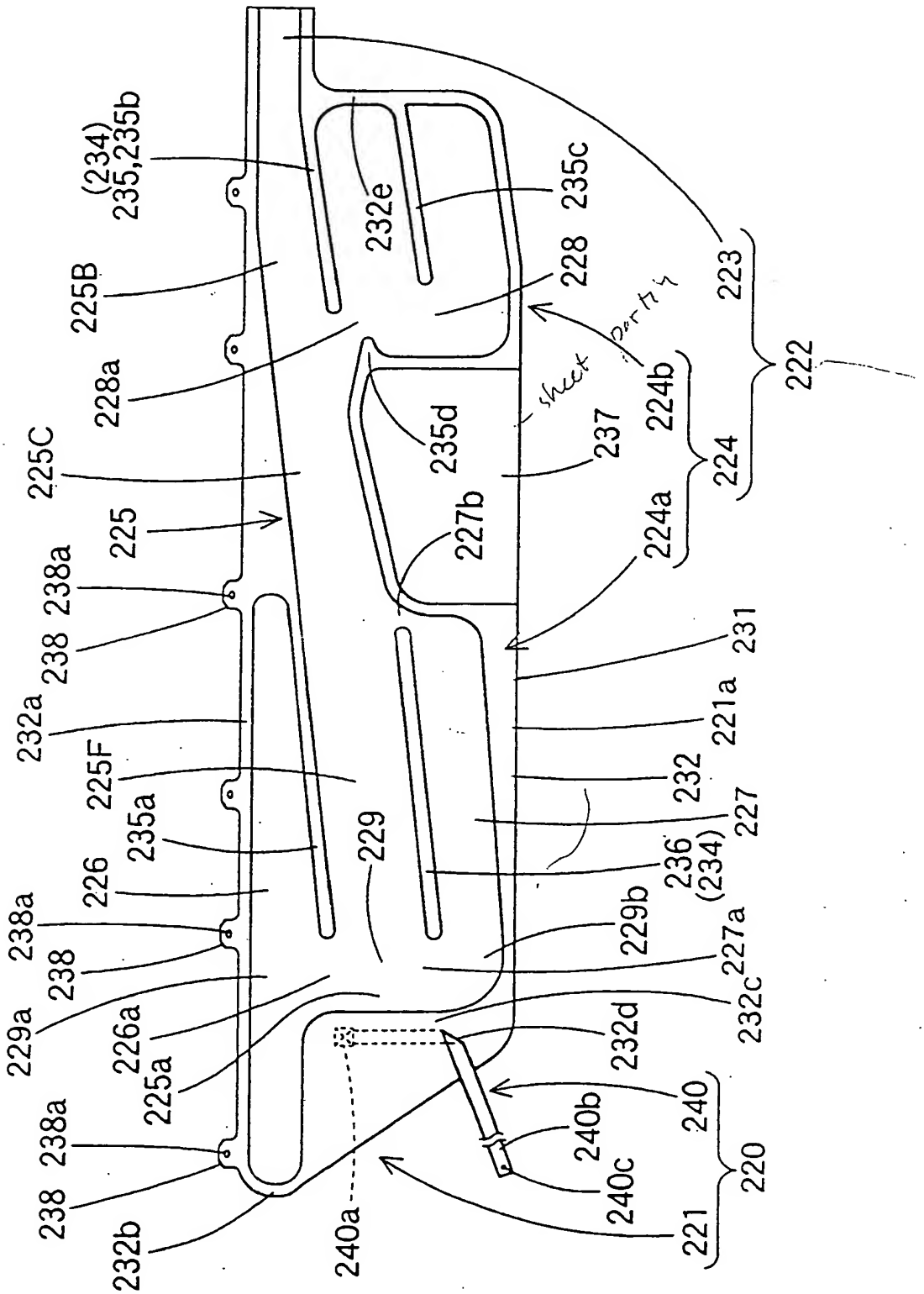

(234)
235,235b
225B
228a
225C
225
238a
238
232a
225F
235a
226
238a
238
229a
226a
225a
238a
238
232b
240a
232e
235c
228
223
222
224b
224
224a
235d
237
227b
231
221a
232
227
236
(234)
229
229b
227a
232c
232d
240
240b
240c
221
220

Fig. 33

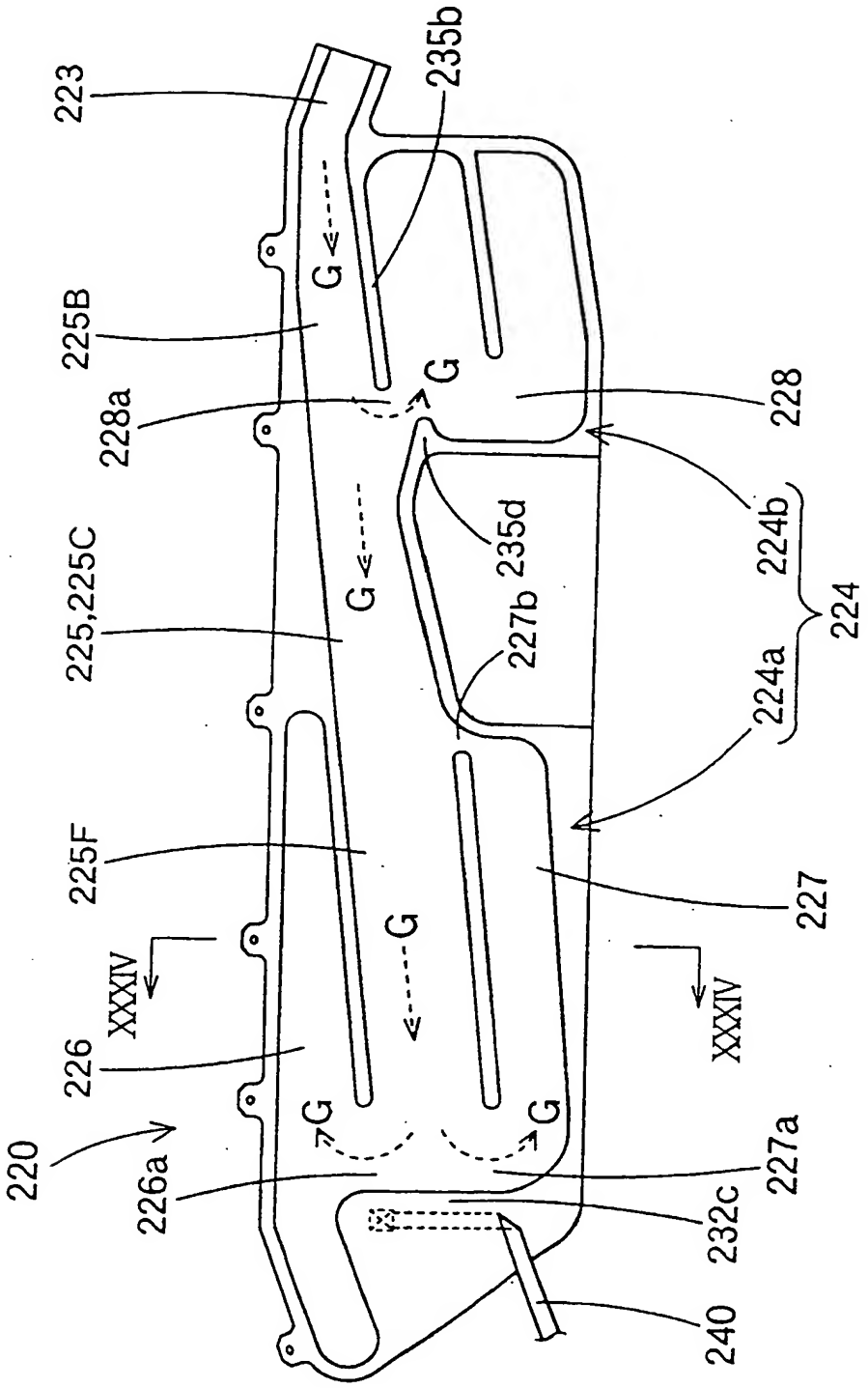

223
235b
225B
228a
G
228
224b
224
235d
225,225C
227b
224a
225F
227
XXXIV
226
220
226a
227a
232c
240

Fig. 35

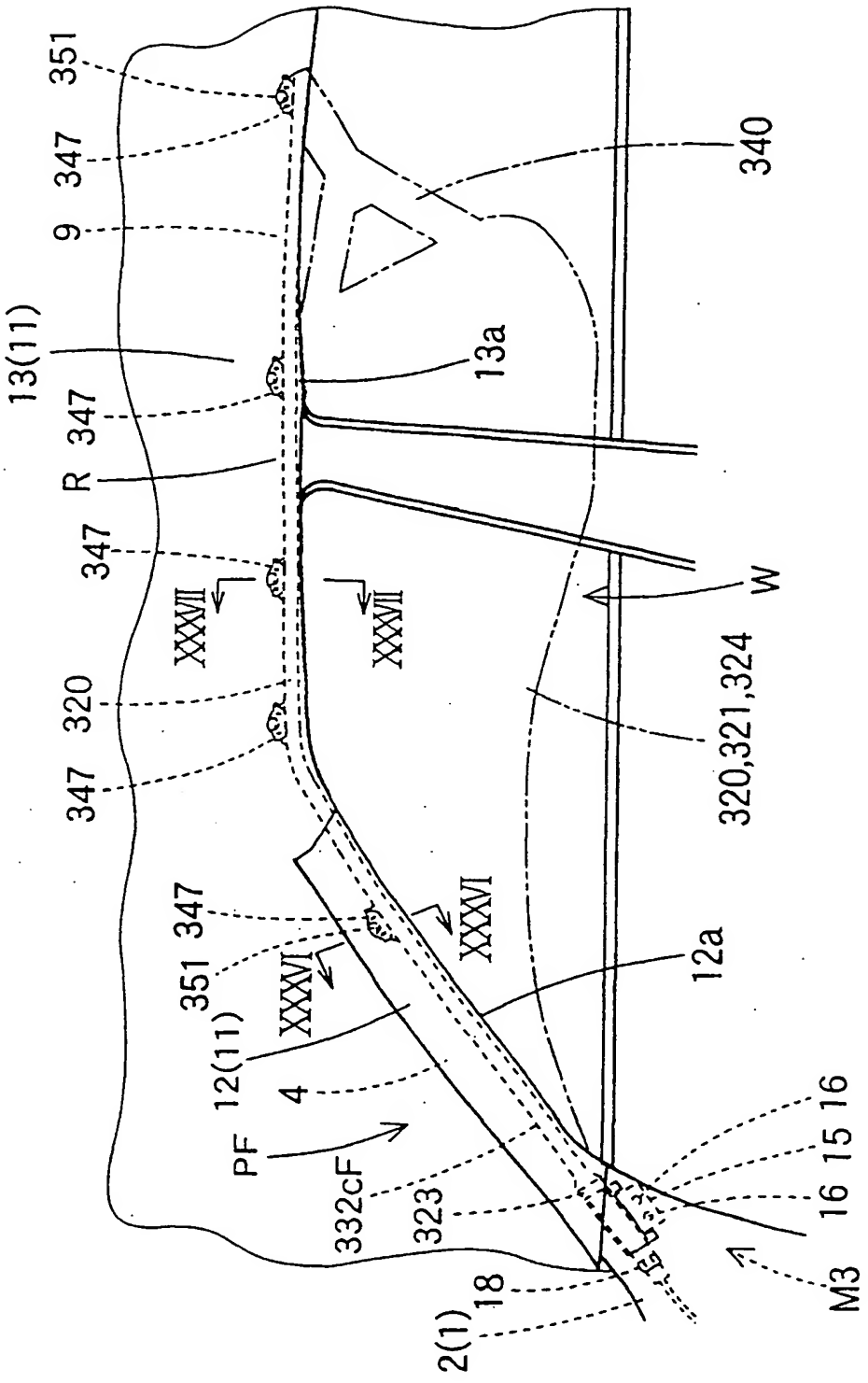
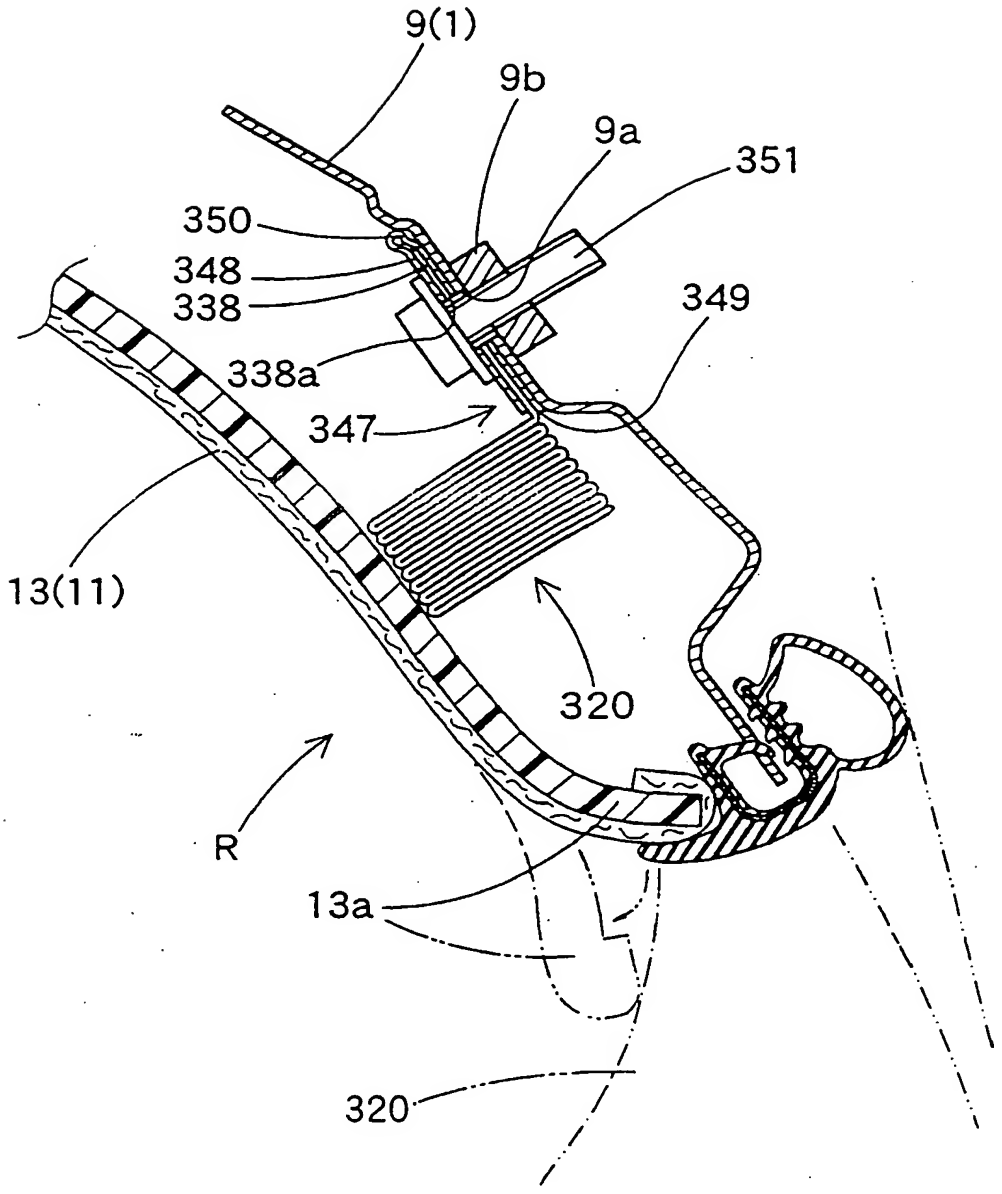

351
347
9
13(11)
347
R
347
320
347
XXXVII
XXXVII
340
13a
W
320,321,324
347
351
12(11)
XXXVI
XXXVI
12a
4
PF
332cF
323
2(1)
18
16
15
16
M3

Fig. 37



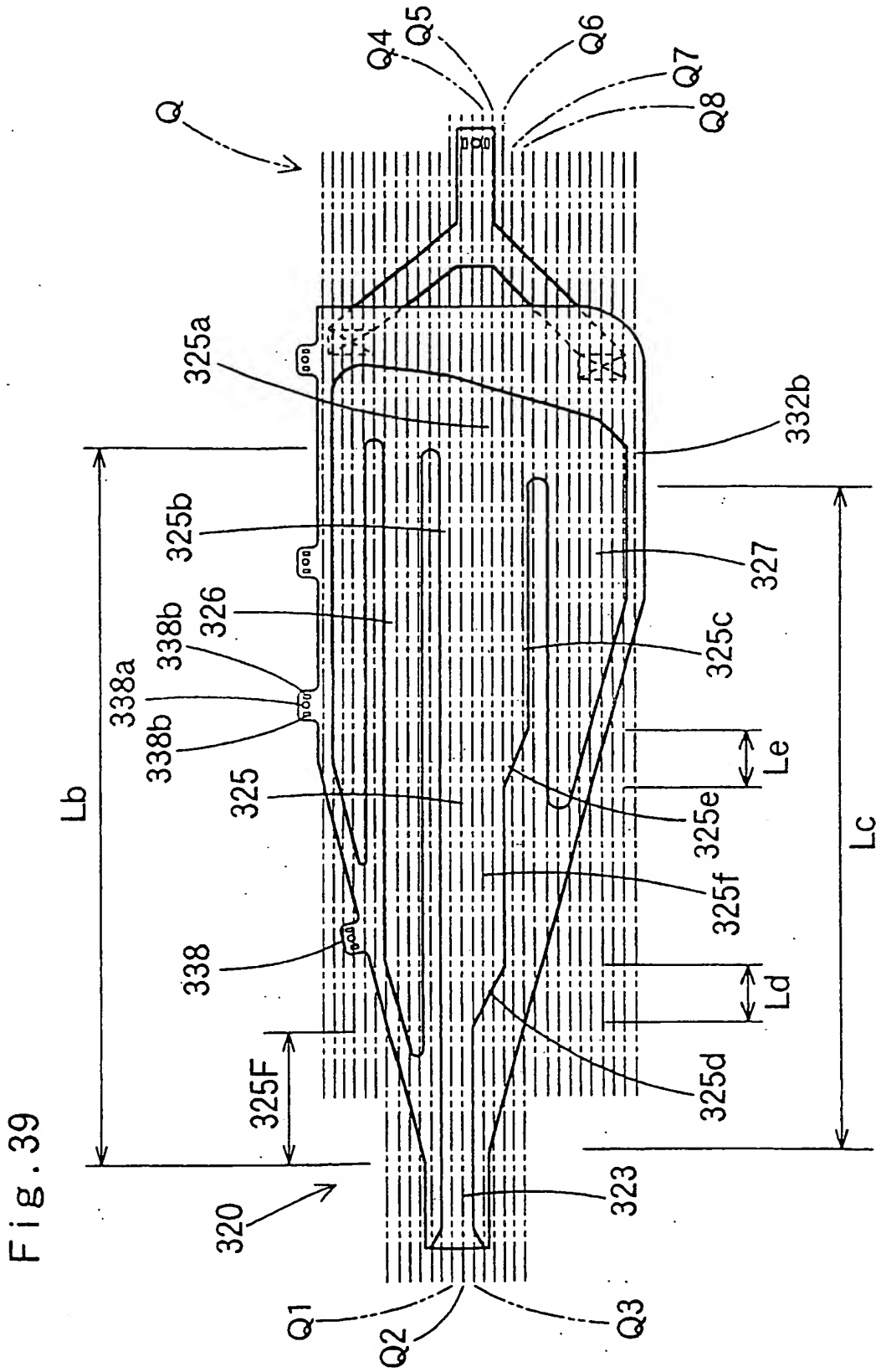
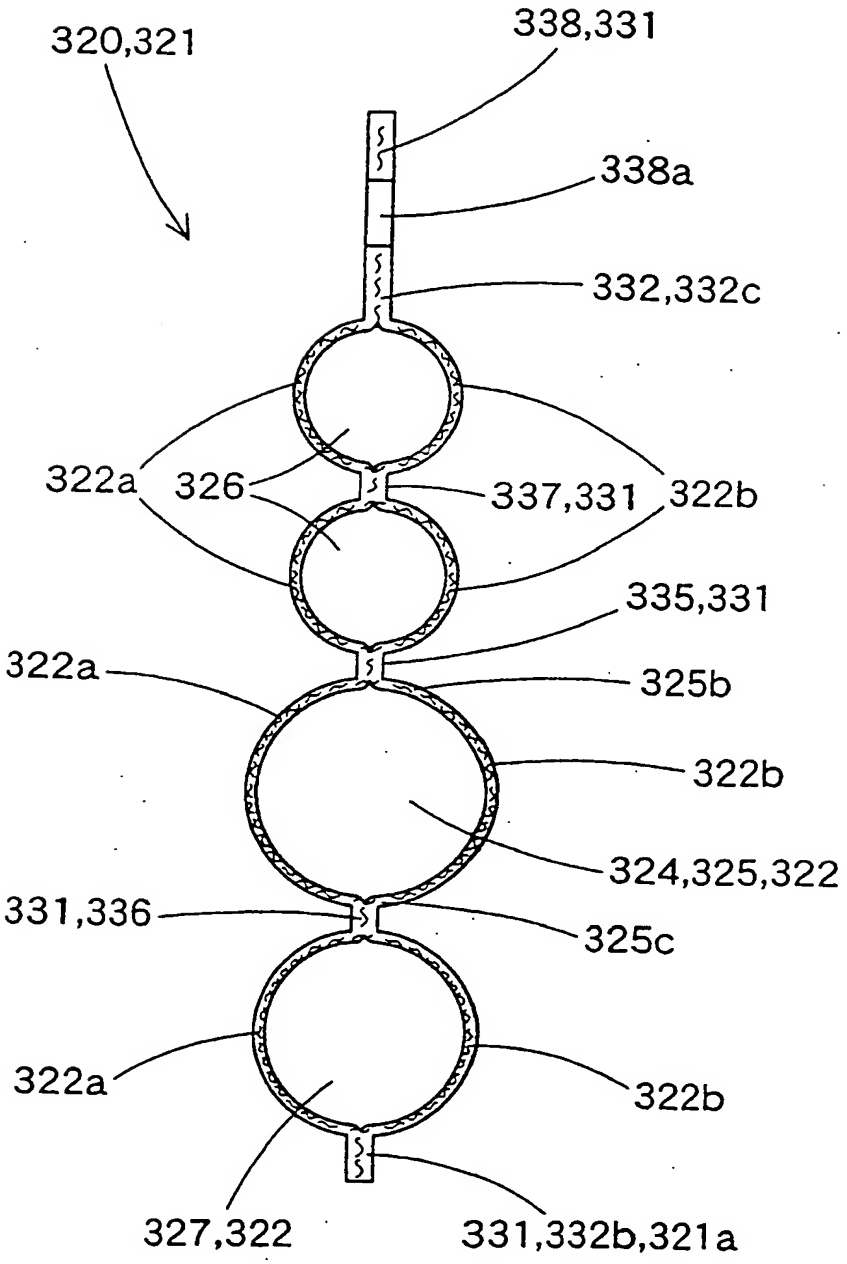

Q
Q4
Q5
Q6
Q7
Q8
325a
332b
325b
327
326
338b
325c
338a
338b
Le
325
325e
Lb
Lc
325f
338
Ld
325d
325F
320
323
Q1
Q2
Q3

Fig.39

Fig. 41


320,321
338,331
338a
332,332c
322a
326
337,331
322b
335,331
322a
325b
322b
324,325,322
331,336
325c
322a
322b
327,322
331,332b,321a

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